INTERNATIONAL MONETARY FUND

COLOMBIA

SELECTED ISSUES

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April 17, 2017

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CONTENTS

MONETARY POLICY AND FINANCIAL CONDITIONS[1]

This paper presents an assessment of the monetary policy stance and broad financial conditions in Colombia, which provides useful insights about macro-financial linkages. First, we provide an assessment of the monetary policy stance using a small open-economy DSGE to estimate the neutral rate. Second, we present a new Financial Conditions Index that captures conditions in the financial sector but controlling for the direct effects of monetary policy and exchange rate movements. The results suggest that both monetary policy and broad financial conditions have remained tight in 2016.

A. Introduction

1.   The monetary policy tightening cycle has come to an end. To contain inflation pressures and ensure that expectations remain anchored, the authorities have raised monetary policy rates by 325 bps to 7.75 percent since September 2015. However, in December 2016 the Monetary Policy Committee (MPC) surprised the market with a 25 bps rate cut. For the MPC, the main reasons behind this decision were that (1) the impact of transitory shocks that pushed inflation away from the target band continued to dissipate rapidly; (2) real GDP growth during 2016Q3 was lower than expected; and (3) ex-ante real interest rates were above their average since 2005. Regarding the latter, it is crucial to determine how the policy rate compares to the neutral rate in order to calibrate the stance of monetary policy.

2.   This paper assesses the monetary policy stance and broad financial conditions in Colombia. A small open-economy DSGE model is used to estimate the neutral rate. However, changes in the monetary policy rate represent only one channel through which monetary policy affects financial conditions, and, in turn, economic activity. Thus, we construct a Financial Conditions Index (FCI) to assess overall financial conditions through three different channels (credit, leverage, and risk) of transmission of the financial sector to the state of the economy. We find that both monetary policy and broad financial conditions have remained tight in 2016. Moreover, the results show that the tightening in financial conditions could have had a sizable impact on GDP growth.

3.   The paper is organized as follows. Section B presents the estimates of the neutral interest rate. Section C presents the FCI. Section G draws conclusions from the above.

B. Neutral Interest Rate

4.   Traditional approaches suggest that the real neutral rate has declined since 2016. In the 2016 Article IV consultation, staff estimated the real neutral interest rate at about 2 percent. Following Magud and Tsounta (2012), different methodologies were used to estimate the neutral interest rate:

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[1] Prepared by Francisco Roch.

- the uncovered interest parity condition (UIP): a no-arbitrage condition stating that the domestic interest rate should equal the foreign interest rate plus the expected change of the exchange rates;

- a Taylor rule augmented for inflation expectations is estimated: a rule in which monetary policy responds to deviations of the inflation from the central bank's target, and of real GDP from its potential level;

- a standard consumption-smoothing model: the neutral interest rate is computed by fitting the Euler equation of a closed economy consumption-saving problem, for reasonable parameter values;

- and, the Hodrick-Prescott (HP) filter: an HP filter is applied to the interest rate series.

Applying these approaches to the most recent data yields an estimated real neutral interest rate of 1.7 percent.[2] The decline in the estimated neutral interest rate is consistent with the downward trend in neutral interest rates in advanced economies documented in Holston et al (2016). Moreover, the Central Bank also provided a range of estimates for the real neutral rate with the median at 1.4 percent (see BanRep 2015).

Table 1. Estimates of the Neutral Interest Rate for Colombia

		Expected Inflation	4.01
		Actual Monetary Policy Rate	7
Method	Neutral Real Interest Rate (NRIR)	Neutral Nominal Interest Rate (NNIR)	Nominal Monetary Policy Gap (bps)
Uncovered Interest Parity	0.6	4.61	-239
Expected-Inflation Augmented Taylor Rule	1.0	5.0	-199
Consumption Based CAPM	3.1	7.11	11
HP-Filter	2.2	6.21	-79
Average	1.7	5.7	-126.5

Source: Staff calculations.

5.   A reduced-form small open-economy DSGE model is also used to estimate the neutral interest rate. The model consists of a standard IS curve summarizing economic activity, a Phillips curve summarizing the determination of inflation, and a Taylor rule capturing the monetary policy reaction function—the first two can be obtained as a log-linear approximation of first order conditions of consumers' and firms' optimization problems in a monopolistic competition setting with price rigidities. The IS equation incorporates the real exchange rate to reflect the impact of open of economy variables on output. The Phillips curve includes a forward-looking component, and a lagged inflation term that captures the inertia of the inflationary process. The monetary policy rule captures the conventional logic where the central bank reacts to inflation and output gaps. In this model the neutral interest rate is the real rate that would prevail if inflation and output gaps were closed. The

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[2] As noted by Magud and Tsounta (2012), and by the wide range above, it is difficult to have a precise estimate of the neutral rate. Moreover, these methodologies ignore financial stability measures which could affect the level of the natural rate, as suggested in Borio et al (2016).

model is estimated using Bayesian methods, incorporating additional information about the parameters through the use of priors. In particular, the posteriors obtained in previous studies for Colombia—Gonzalez and Hamann (2011) and Hamann et al (2014)—were used as priors.

IS curve:

$$x_t = 0.9x_{t+1} - 0.94(r_t - r_t^*) + 0.01e_t + \varepsilon_t^{IS}$$

Phillips curve:

$$\pi_t = 0.62\pi_{t-1} + 0.38\pi_{t+1} + 0.32x_t + \varepsilon_t^P$$

Taylor rule:

$$r_t - r_t^* = 0.18\pi_t + 0.03x_t + \varepsilon_t^T$$

where x is the output growth gap (the deviation of observed annual real GDP growth with respect to its trend), π is the (core) inflation rate (in deviation with respect to the inflation target), r is the real (ex-post) policy rate, r^* is the neutral real interest rate, and e is the rate of depreciation of the real exchange rate.

The depreciation of the real exchange rate is modeled as an AR(1) process:
$$e_t = 0.72e_{t-1} + \varepsilon_t^e$$

The neutral interest rate follows a simple process with persistent shocks z:
$$r_t^* = 1.1 + z_t$$
$$z_t = 0.91z_{t-1} + \varepsilon_t^z$$

6.   The neutral interest rate for Colombia is found to have declined since 2007 (Figure 1). This finding is robust to various changes in the model specification. The results suggest that currently the real neutral rate is about 0.7 percent. However, the level of the estimated neutral rate depends on the specification of the model and shock assumptions. The (ex-ante) real policy rate is currently about 3 percent. Thus, based on the estimated DSGE model, the monetary policy stance is tight. Finally, the model is used for forecasting analysis and suggests that the pace at which the central bank should lower the policy rate depends on, inter alia, the impact of the VAT increase (Table 2). The model projects a consolidation of the recent downward inflation trend after a one time increase due to the VAT, and an easing to a terminal rate of about 5.6 to 6 percent in 2017.

Figure 1. Interest Rates
(In Percent)
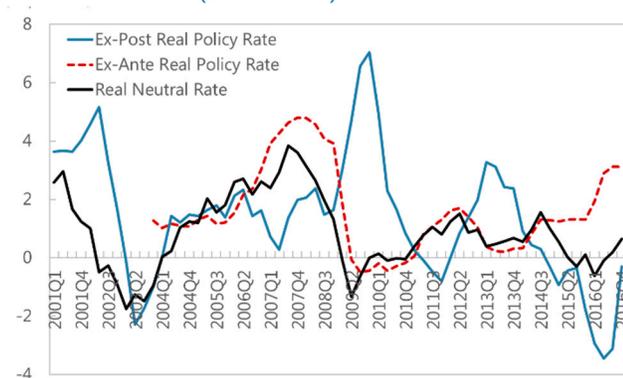
Source: IMF staff calculations.

Table 2. Inflation and Policy Rate

|	Baseline				With VAT		
	Core Inflation (qoq, saar)	Core Inflation (yoy)	Policy Rate		Core Inflation (qoq, saar)	Core Inflation (yoy)	Policy Rate
2016Q4	3.34	6.15	7.50	2016Q4	3.343	6.150	7.500
2017Q1	3.29	4.55	6.34	2017Q1	4.300	4.811	7.499
2017Q2	3.22	3.68	6.05	2017Q2	3.943	4.126	6.892
2017Q3	3.16	3.29	5.83	2017Q3	3.689	3.874	6.439
2017Q4	3.12	3.23	5.64	2017Q4	3.491	3.912	6.065

C.   Financial Conditions Index

7.   A Financial Conditions Index (FCI) extracts information from a series of financial variables to provide a quantitative assessment of overall financial conditions in the economy. Changes in the policy interest rates represent only one dimension of the evolution of overall financial conditions in the economy. The impact of policy rates on other financial variables—in particular, credit, asset prices, and the exchange rate—is also an important part of the monetary policy transmission mechanism. If the transmission from policy rates to these financial variables is incomplete or unstable, assessing overall financial conditions requires looking at these variables as well.

8.   In the 2016 Article IV Consultation an FCI for Colombia was constructed using a vector autoregressive (VAR) approach. The FCI captured in one indicator the information in stock market prices, sovereign spreads, the REER, the policy rate, lending rates, and the VIX. In this approach the weights of each financial indicator were assigned according to the estimated impact on real GDP growth in a VAR model. The results suggested that financial conditions eased continuously from the third quarter of 2014 until the third quarter of 2015, and then began reacting mildly to the policy rate hikes by the end of 2015. However, the loose financial conditions reflected largely the depreciation of the currency (Figure 2), which was performing an important role in the current adjustment process in Colombia. Thus, next we construct a new FCI using a methodology that estimates financial conditions adjusting for the business cycle and monetary policy.

Figure 2. Contributions to FCI, 2010Q1−2016Q4
(Percentage points of annualized q/q growth)

Sources: Haver and staff calculations.
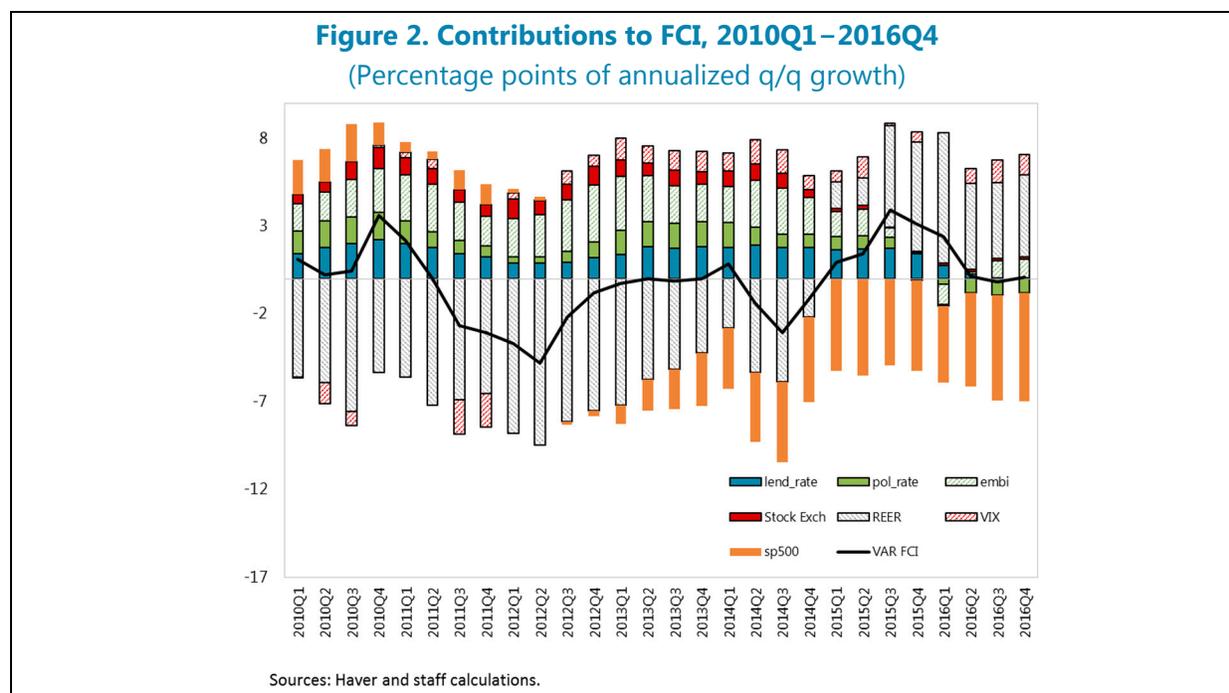
9.   A factor-augmented vector-autoregression (FAVAR) is used to estimate the FCI. Following Koop and Korobilis (2014) the model features time-varying parameter FAVARs (TVP-FAVARs) which allow coefficients and loadings to change in each period. Morevoer, two other useful special cases in which the VAR parameters are not time-varying are estimated: (1) the principal components-based factor-augmented VAR (PCA-FAVAR) proposed by Stock and Watson (2002) and Bernanke, Boivin, and Eliasz (2005); and (2) the Kalman-filter-based factor-augmented VAR (KF-FAVAR) by Doz, Giannone, and Reichlin (2011). The empirical model is given by

$$X_t = \lambda_t^y Y_t + \lambda_t^f f_t + u_t,$$

$$\begin{bmatrix} Y_t \\ f_t \end{bmatrix} = B_{1,t} \begin{bmatrix} Y_{t-1} \\ f_{t-1} \end{bmatrix} + B_{2,t} \begin{bmatrix} Y_{t-2} \\ f_{t-2} \end{bmatrix} + \ldots + \varepsilon_t,$$

in which X is a vector of 20 financial variables, Y is a vector of macroeconomic variables (inflation, real GDP growth, the real effective exchange rate, and the monetary policy rate), f is an unobservable factor, and ε and u are uncorrelated (but heteroskedastic) error terms. In this setting, the factor f is the financial conditions index (FCI) and the coefficients λ^y and λ^f are the factor loadings which track the effect of both macroeconomic and financial conditions on each financial variable.

10.   Financial conditions have deteriorated and remained tight during 2016 (Figure 3). The FCI is normalized around 0 over the observation period (2001–16) and values above zero indicate "loose" and below zero "tight" conditions. The constructed FCI is purged of cyclical influence by controlling for GDP growth; and fluctuations in the FCI do not capture the direct effects of monetary policy decisions as its derivation controls for the policy rate. Variables included in the FCI cover three main dimensions: risk (several interest rate spreads and asset price volatilities), collateral values and

leverage (measures of bank leverage, housing and stock prices), and credit (commercial, consumption, and mortgage).

Figure 3. Financial Conditions Index

Source: IMF Staff calculations.

Figure 4. Economic Activity and Financial Conditions
(Percent)

Source: IMF staff calculations.
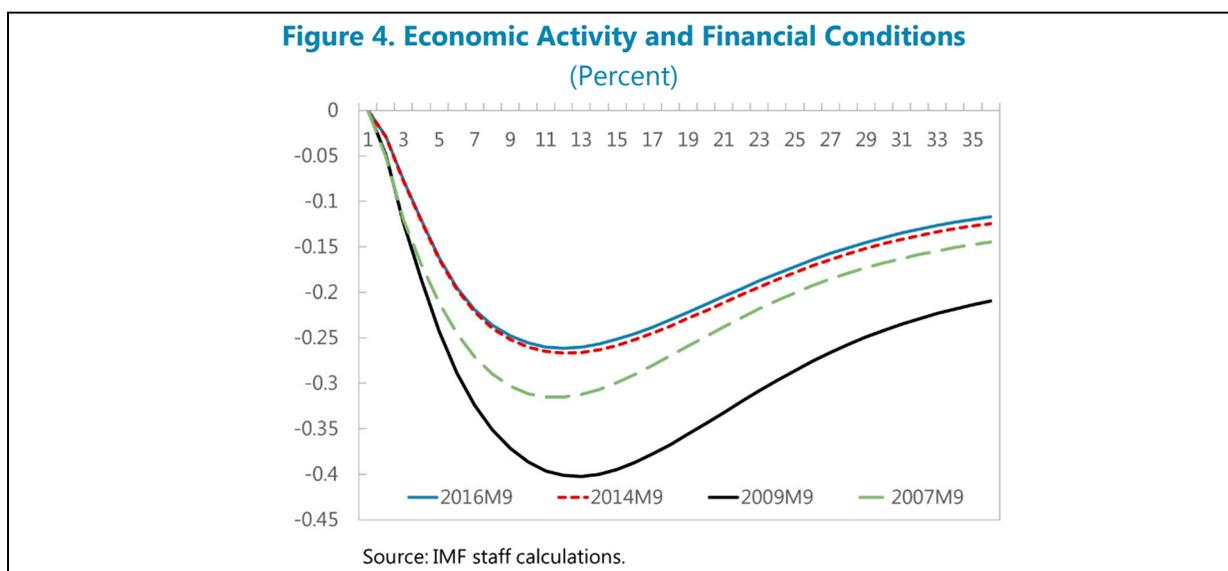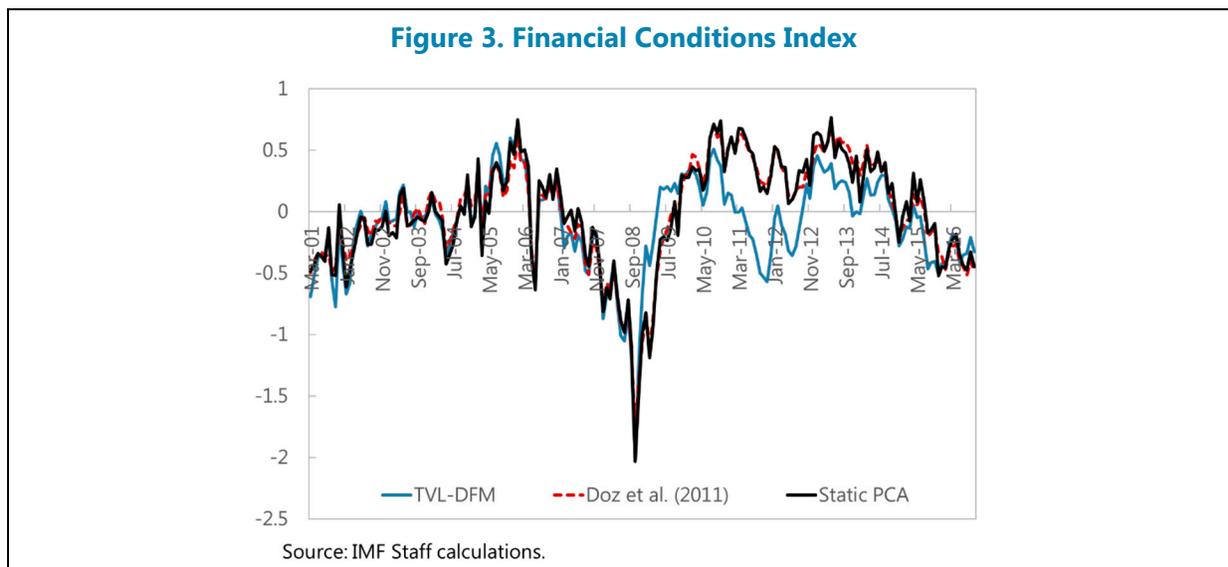
11.   Tightening financial conditions contributed to the slowdown in economic activity (Figure 4). The impulse response function analysis shows that a 1 standard deviation tightening of financial conditions lowers GDP growth by about 0.25 percentage points within 12 months. The estimated FCI suggests that financial conditions tightened by one standard deviation in 2015, and one fifth of one standard deviation in 2016. Hence, the impulse response analysis suggests that this cumulative tightening in financial conditions would continue weighing on growth in 2017 subtracting around 0.2 ppts.

D. Conclusion

12.   The monetary policy tightening has brought the policy rate above the neutral rate. To contain inflation pressures and ensure that expectations remain anchored, the authorities raised the monetary policy rate by 325 bps to 7.75 percent between September 2015 and August 2016. With the recent cuts and inflation expectations at 4 percent, the current (ex-ante) real policy rate is around 3 percent, above our assessment of a neutral range of 1–2 percent. Moreover, on top of the monetary policy tightening, overall financial conditions have remained tight in 2016 which will continue dragging growth this year. Hence, with inflation on a decreasing path and expectations falling inside the target band, the central bank has room to continue with the easing cycle—though the precise timing of cuts should depend on a consolidation of these trends.

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HOUSING FINANCE AND REAL ESTATE MARKETS IN COLOMBIA[1]

Colombian house prices have increased significantly between 2005 and 2016. This paper estimates the extent of misalignments in house prices relative to fundamentals and evaluates the overall risk to the economy from the housing sector. The results suggest a moderate house price misalignment relative to fundamentals which is, however, mitigated by housing finance characteristics.

A.   Introduction

1.   Colombian house prices have increased significantly between 2005 and 2016. In the main three cities of Colombia (Bogota, Cali, and Medellin), house prices rose by around 200 percent in nominal terms (110 percent in real terms) from 2005 to mid-2016 (Figure 1). In addition, some housing indicators (including the housing affordability ratio, the ratio of house prices to rent, and mortgage debt) have reached historically high levels. These developments generate questions about the sustainability of these price increases, and the macro-financial risks associated with potential reversals in the housing and mortgage markets.

Figure 1. House Prices

Existing and New Housing Prices
(Index, 2005Q1=100)

Sources: Haver.
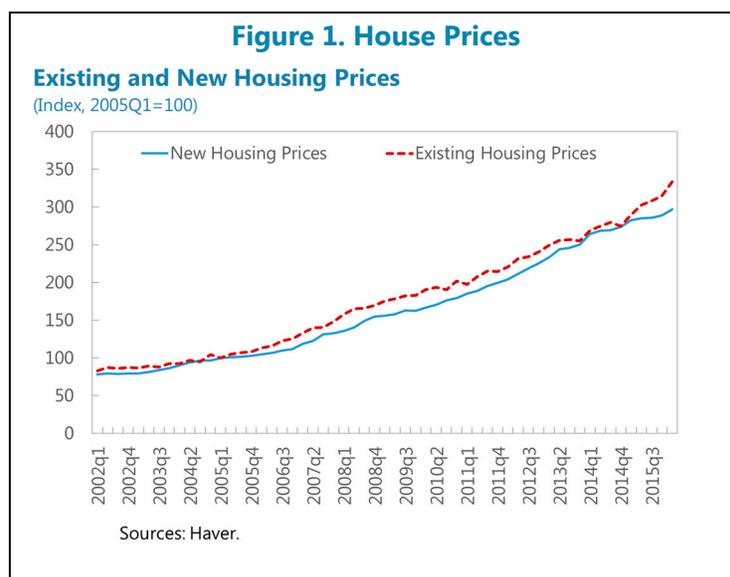
2.   This paper estimates the extent of misalignments in house prices relative to fundamentals in Colombia and evaluates the overall risk to the economy from the housing sector. First, the paper documents recent developments in mortgage credit and the housing sector in Colombia. Second, it examines the extent to which characteristics of the Colombian housing finance system could lead to potential fragilities. Third, misalignments in house prices relative to fundamentals

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[1] Prepared by Francisco Roch. Staff from the Banco de la República provided useful comments.

are estimated using an error-correction model, relating short-term changes in house prices to a long-term equilibrium relationship, interest rates, and to changes in income per capita and credit growth.

3.   **We find some degree of house price misalignment relative to fundamentals which is, however, mitigated by housing finance characteristics.** The model results suggest that house prices are around 13 percent above equilibrium. Nevertheless, after the financial crisis of 1999, the authorities have addressed possible mortgage financing vulnerabilities from the housing market. In particular there is a ceiling on loan-to-value ratios of 70 percent (80 percent for social interest housing), mortgages are usually contracted at a fixed interest rate, and there is full recourse on mortgages. Thus, the soundness in housing finance contracts and regulations would mitigate the negative spillovers from a potential correction in house prices.

4.   **The paper is organized as follows.** Section B presents recent developments in the housing market. Section C describes the characteristics of housing finance in Colombia. Section D examines the misalignment of house prices relative to fundamentals, and Section E concludes.

B.   Recent Developments in the Housing and Mortgage Markets

5.   **While the total housing deficit has been steadily declining, home ownership is still low.** Out of 14 million households in 2015, 46 percent live in their own homes, 38 percent rent the house where they live, and 16 percent enjoy free usufruct. Home ownership in Colombia is among the lowest in the region. The total housing deficit was estimated at 25 percent of the total number of households in 2014, down from 54 percent in 1993 (Figure 2). The total housing deficit is usually split between quantitative and qualitative deficit.[2] In 2014, the total quantitative and qualitative deficit were estimated at 9 and 15 percent of the households, respectively. Not surprisingly, the total housing deficit is much larger in rural areas (48 percent in 2014) than in urban areas (18 percent in 2014). The dynamics of the housing deficits have been positive except for the quantitative deficit in rural areas, where it has increased from 7 percent in 1993 to 18 percent in 2014. However, estimates by the IDB suggest that Colombia stands well in the region with a similar housing deficit to higher income per capita countries (Figure 2).[3]

6.   **Construction activity has recovered from the crisis and has reached historical levels.** Construction activity declined sharply during the Colombian financial crisis of the late 1990s, bottoming out in 2000 with a share of construction in GDP of around 4 percent (Figure 3). Since then, the participation of construction has increased steadily, with a minor deceleration during the global financial crisis, reaching 9.7 percent in 2015. The construction licenses index provides a measure of the potential of construction activity at the country level. The dynamics of this index has been in line with that of the construction share in GDP, showing strong growth except during the 2008 financial

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[2] The quantitative deficit is measured by the number of households that do not have an independent house while the qualitative deficit takes into account the quality and condition of houses and their access to basic services.

[3] The IDB uses a homogeneous approach to estimate housing deficits across Latin American countries. However, the latest estimations are from 2009, and will be updated only in 2018.

crisis. However, construction licenses have declined in 2016 suggesting that construction activity might start slowing down, in line with overall economic activity (Figure 3).

Figure 2. Housing Deficit
(Percent of households)

Source: Dane

Figure 3. Construction Activity

Construction Sector Share
(Percent of GDP)

Source: DANE.

New Construction Licenses
(Index, 2015 = 100)

Source: DANE.
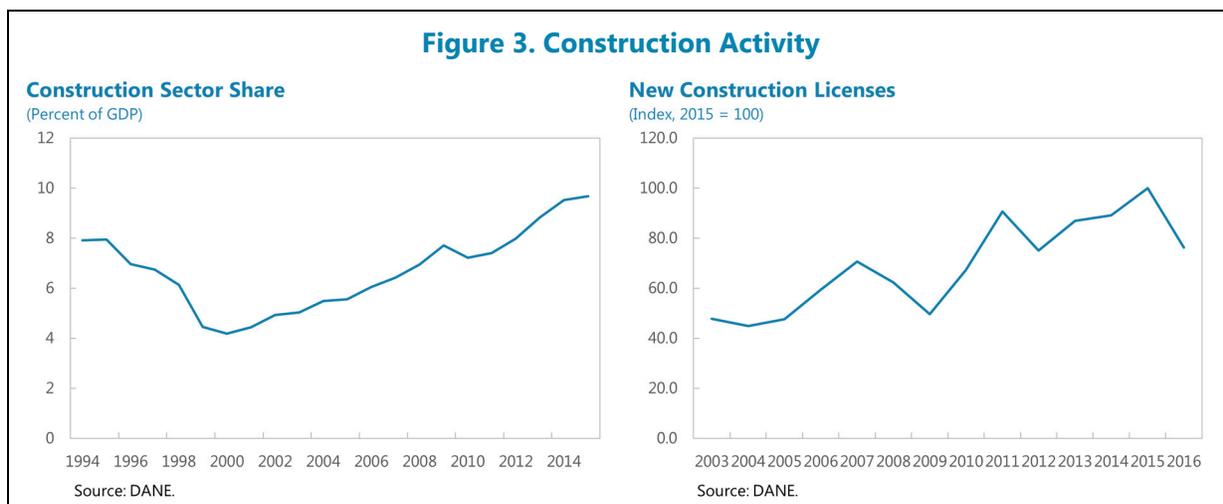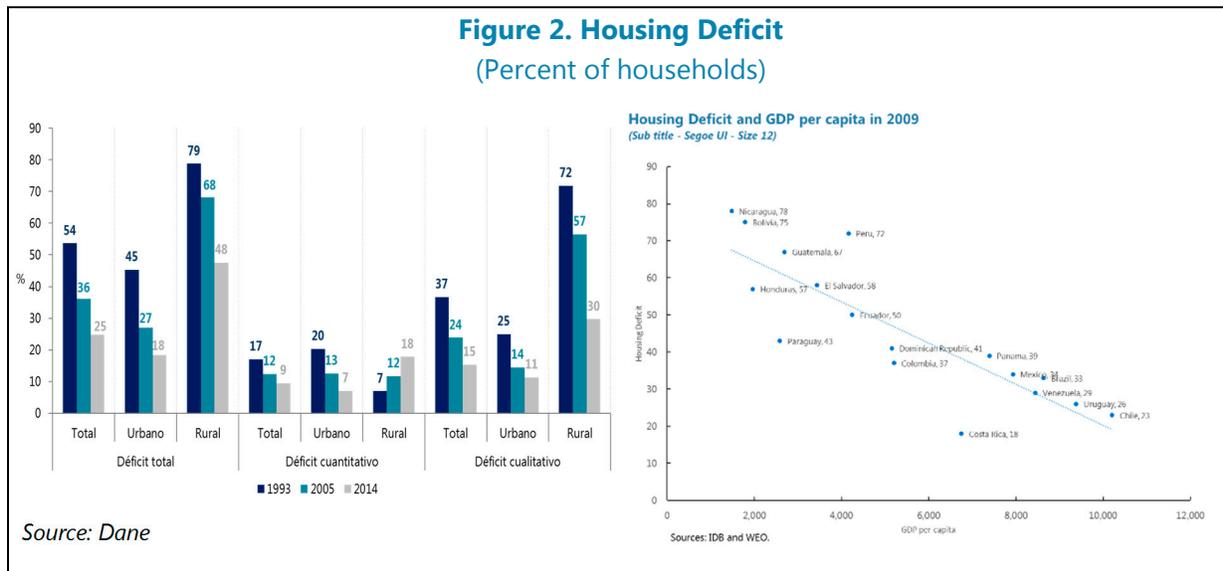
7.   The increase in house prices has been widespread across the country. Figure 1 shows that prices for both new and existing houses have increased in the main three cities of Colombia. Figure 4 shows the evolution of prices for new houses in additional cities. Interestingly, house prices grew at high and similar rates in the seven cities considered: the average home-price index grew by an annual real rate of 5.18 percent between 2005 and 2016, with Bucaramanga having the highest average annual real growth rate (8 percent) and Armenia the lowest (3.4 percent). Notwithstanding, in all the cities house prices tended to show stronger growth for middle and upper income levels (Figure 4).

Figure 4. House Prices by Region and by Income Level

New Housing Prices by Region
(Index, 2014Q4 = 100)

Source: DANE.

New Housing Prices by Income Level
(Average annual growth rate, 2005-2016)

Source: DANE.
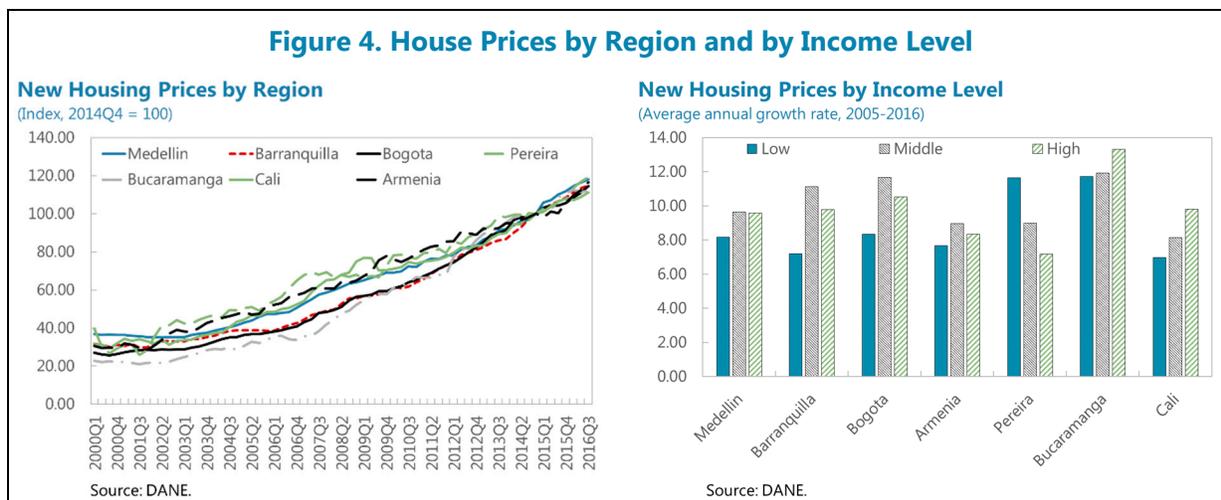
8.   Mortgage credit experienced a significant expansion during the past decade. While all types of credit (consumption, commercial, and mortgage) increased substantially in real terms since 2005, growth in mortgage credit has been particularly strong since 2011 (Figure 5). As a consequence of favorable external conditions, strong fundamentals and mortgage credit subsidies, real mortgage credit has grown by an annual average of 13 percent since 2011. The expansion in mortgage credit is in line with the growth of the construction sector described above. However, despite the rapid credit growth, mortgage credit in Colombia is still low and stands at about 5 percent of GDP (Figure 5), below the levels of other emerging economies. Government subsidies have also played a role in the recent mortgage expansion (see Box 1).[4]

Figure 5. Mortgage Credit

Credit by Market Segment (in real terms, Index, 2005Q1=100)

Sources: BanRep and Haver.

Credit to GDP by Market Segment

Sources: BanRep and Haver.
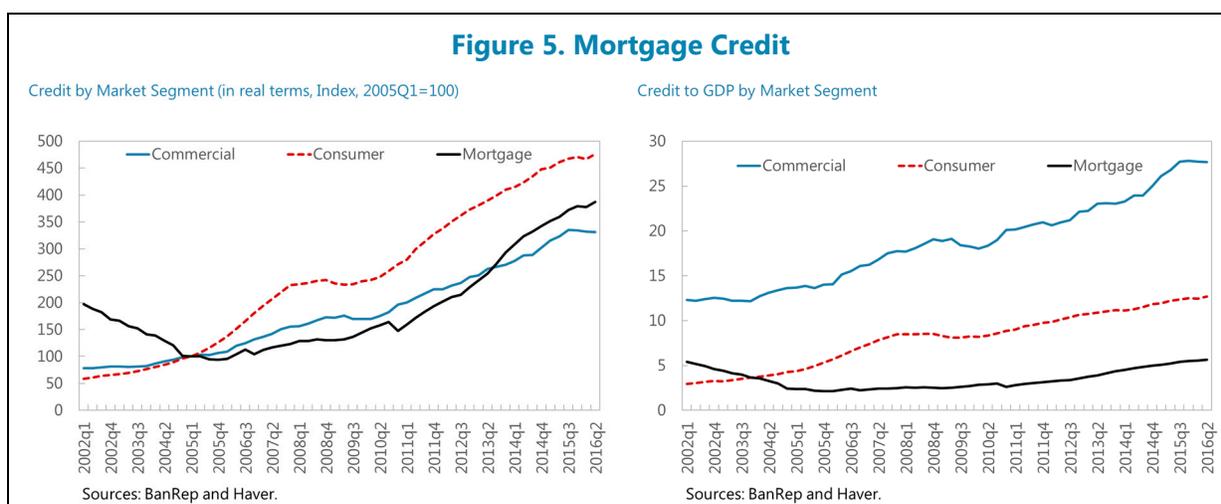
[4] Around 30 percent of the mortgages originated in 2016 were subsidized.

Box 1. Government Housing Programs

Government housing programs have expanded in recent years, partly in response to the economic slowdown. Traditionally, government housing programs have aimed to reduce gaps in home ownership and improve social conditions. At the same time, in recent years, new housing programs have been used as a countercyclical response to country-wide economic slowdown exploiting the spillovers that construction activity has into other sectors (official estimates suggest the construction sector is interconnected with 25 percent of the industrial sector). Examples of the latter are mortgage subsides targeting middle-income households included in the government programs PIPE (Plan to Boost Productivity and Employment) in 2013 and PIPE 2.0 in 2015. The number of houses sold with mortgage subsidies increased from about 21,000 in 2013 to about 33,000 in 2016.[5]

Existing housing programs combine support for down payments and subsidized mortgage interest rates. The government has a standing program to provide free housing to the most vulnerable including people displaced by the conflict with the FARC. Further, the program *Mi Casa Ya* targets households with income between 2 and 4 minimum wages and for houses worth up to US$30,000. The program offers support for down payments and a subsidy for interest payments.[6] Another program, FRECH, offers only interest rate subsidies (4–5 percentage points) and targets households earning up to 8 minimum wages and houses worth up to US$50,000. Finally, FRECH No-VIS is aimed at middle-income households providing interest rate subsidies (2.5 percentage points) for houses worth up to US$77,000 and is open to any household regardless of its income level. [7] The government fund sets annual ceilings (*cupos*) for the number of houses to be subsidized under each program; the programs are only for new houses.

Data suggest housing programs have contributed to Colombia's relatively strong economic performance over the last few years. The construction sector has outpaced total GDP growth during most of the last years, supported in part by an increase in residential construction. The data shows a clear boost to construction exactly at the time of PIPE in 2013; at the same time, the response to PIPE 2.0 has been more muted (other key drivers of construction activity include subnational expenditure execution, and the authorities' infrastructure agenda). Official estimates suggest the fiscal multipliers of the housing program varies from 10 for FRECH No-VIS to 1 for the free housing program.

GDP and Construction
(YoY; in percent) —— GDP —— Construction Sector GDP

Sources: National authorities and Fund staff calculations

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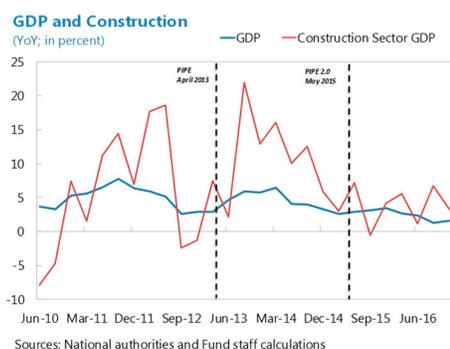
[5] Excludes houses worth more than US$30,000.

[6] Within the program Mi Casa Ya, there are different subprograms including Mi Casa Cuota Inicial, Mi Casa Ahorradores and Mi Casa Ya Subsidio a la tasa. For a full description of the programs see: http://www.banrep.gov.co/sites/default/files/publicaciones/archivos/iepref_mar_1_2016.pdf

[7] House values limits are defined in number of minimum wages. For 2016, the values are converted using the official monthly minimum wage of US$230.

C. Housing Finance Characteristics

9.   Housing finance systems differ considerably across countries and several mortgage markets characteristics are associated with deeper and/or more stable markets. This section presents the existing empirical evidence of the following house financing characteristics on financial stability: maximum observed loan-to-value (LTV), term to maturity, funding model, degree of lender recourse on mortgages, interest type, and prepayment penalties. Moreover, for each characteristic, Colombia is compared to advanced and emerging economies.[8]

10.   Maximum observed LTV. LTV ratios on new loans vary widely across countries, and a number of countries have used regulatory LTV ceilings to mitigate housing booms or increase resilience against a bust. Recent empirical studies support the effectiveness of LTV limits as a macroprudential tool. Crowe et al (2011) find that house prices decline between 8 and 13 percentage points after a 10 percentage point reduction in the LTV ratio. According to Claessens et al (2012), emerging markets should impose lower LTV limits given that they tend to experience more severe financial downturns than advanced economies. Almeida et al (2006) indicate that LTV ceilings affect the financial accelerator mechanism by reducing the transmission from increases in income to increases in house prices. Figure 6 shows that the maximum observed LTV ratios in the majority of countries seem to be between 70-80 and 90-100, with a median of 83 percent. It ranges from 70 percent (Colombia, Hong Kong SAR, and Hungary) to 125 percent (the Netherlands). In Colombia, the LTV ratio is at 53 percent, below the regulatory ceiling.[9]

11.   Term to maturity. The maturity of mortgage loans could affect the depth of mortgage markets and house prices by influencing affordability. Intuitively, the possibility of opting for longer maturity loans could increase affordability (through lower monthly payments) leading to an increase in the demand for mortgages and homeownership. Figure 6 shows that the maturity of mortgages ranges from 7 years (Turkey) to 45 years (Sweden), with a median of 25 years. In the case of Colombia, the average maturity of a mortgage loan is 15 years. However, the effective duration is around 6–7 years due to early prepayments.

12.   Funding model. The way that banks fund the origination of mortgage loans tends to play a role in the rate of credit growth and, consequently, affects house prices and financial stability. For instance, credit growth is usually stronger in an economy in which securitization plays a bigger role than in an economy dominated by bond financing. Mortgage securitization was associated with a deterioration in underwriting standards in the United States, while covered bonds have contributed to safer mortgages in Europe. However, while there is heterogeneity across countries' funding models, in most countries banks use retail deposits as the primary source of financing. This is also the case for Colombia.

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[8] The international comparison is based on Cerutti et al (2015).

[9] See the March 2016 Financial Stability Report for additional references.

Figure 6. Cross-Country Housing Finance Characteristics

Source: Cerutti et al (2015)
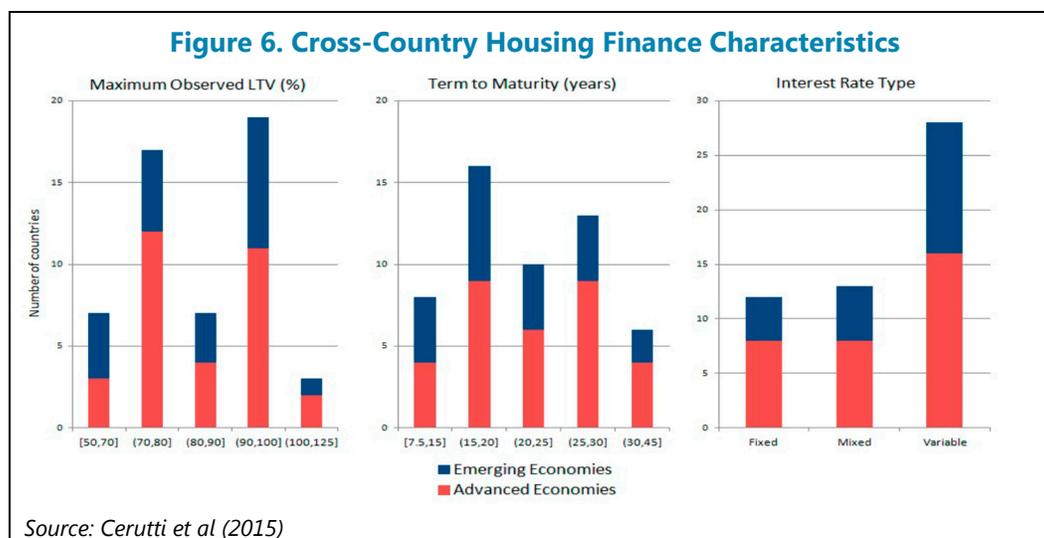
13.   Degree of lender recourse on mortgages. A full-recourse mortgage loan allows the lender to pursue deficiency judgments, i.e., to pursue a borrower's assets (other than the house securing the mortgage) in case of a default. In contrast, a nonrecourse mortgage implies that the lender has recourse only to the underlying property. Dugyan-Bump and Grant (2008) document that the use of full-recourse mortgage loans has been associated with lower default rates in Europe. Morevoer, Ghent and Kudlyak (2011) and Jagtiani and Lang (2010) show that strategic default rates were higher in those states of the United Sates where mortgage loans are treated as nonrecourse debt. In the case of Colombia, there is full recourse on mortgages.

14.   Interest type. Figure 6 shows that there is also heterogeneity in interest determination across countries. In the sample collected by Cerutti et al (2015), variable-rate mortgages are the dominant instrument in 30 countries, and fixed-rate mortgages in 12 countries; while both types are observed in 14 countries. Moreover, variable rates are more common in emerging economies. In the case of Colombia, both variable- and fixed-rates mortgages are offered. However, given the role that mortgage interest rates played in the Colombian financial crisis (see Box 2), the majority of households have a tendency to choose fixed-rate mortgages.

15.   Prepayment penalties. Ellis (2008) suggests that the lack of prepayment penalties in the United States contributed to the increase in household leverage and mortgage indebtedness through cash-out refinancing and second mortgages, which could lead to mortgage market volatility. Most countries allow a partial repayment (typically 20 percent) without penalty. There are no prepayment penalties in Colombia and borrowers frequently make partial prepayments.

Box 2. The 1998–99 Financial Crisis

The origins of the financial crisis in 1998–99 can be traced to events in the early 1990s, when Colombia underwent a process of financial and trade liberalization, together with a considerably reduction in public and private savings. Public spending increased substantially as a result of the constitutional reform of 1991, which introduced large social programs and higher expenditure by regional and municipal governments. As a result, the public deficit deteriorated from near balance in 1992 to around 4 percent in 1998. At the same time, the combination of the financial deregulation process and favorable external financing conditions triggered large capital inflows that were intermediated by the domestic financial system, which contributed to the decline in private savings from 14.1 percent of GDP in 1990 to 8.7 percent of GDP in 1998. As a result, the current account worsened from a 2 percent surplus in 1992 to a 6 percent deficit in 1998, giving rise to a large credit expansion that fueled a boom in asset prices (particularly in the real estate sector). Bank credit as a share of GDP doubled between 1991 and 1997, making the financial system vulnerable due to weak regulatory and supervisory systems.

Between 1997 and 1999, growing concerns about the sustainability of these macroeconomic imbalances together with a reversal in capital flows due to the Asian crisis resulted in speculative attacks on the domestic currency. The authorities responded by depreciating the exchange rate band and tightening monetary policy. The monetary policy tightening and the reversal in capital flows affected the financial system through a reduction in liquidity and a subsequent increase in the cost of funds. Moreover, in 1993 the indexation of mortgage loan rates switched from the UPAC (an inflation index) to a market interest rate (the 90-day deposit rate). Thus, the rise in real interest rates, coupled with the fall in

Real Growth Rates
(Percent)

Sources: DANE and BanRep.

house prices, affected the financial burden of households, thereby leading to higher NPLs and worse solvency ratios of intermediaries. In the end, output fell by more than 4 percent in 1999, and real estate prices contracted by nearly 27 percent in real terms.
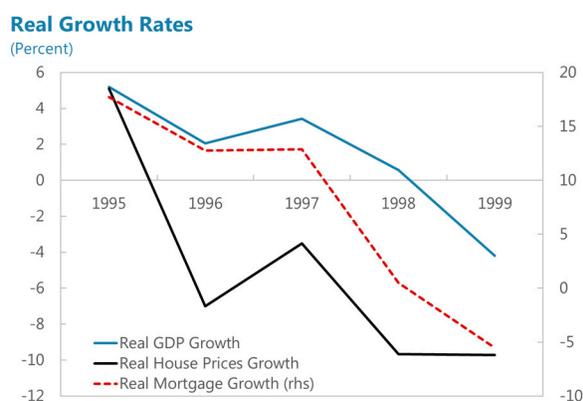
D. House Price Determinants

16.   Standard models of house price determinants postulate that the growth rate of real house prices is explained by the following factors:

- Past growth rates of real house prices. This would capture the persistence in the growth rate of house prices.

- Past housing affordability ratio. The long-term equilibrium relationship is measured using the ratio of house prices to income which is a measure of affordability.

- Economic fundamentals. The growth rate of house prices should be positively affected by per capita real income growth (which increases households' purchasing power and borrowing capacity) and mortgage credit growth (as households are less credit rationed), while negatively affected by interest rates (as lower rates increase households' capacity to borrow). Finally, the

growth rate of households (proxied by population growth) should also affect the growth rate of house prices positively.

17. **Misalignments in house prices relative to fundamentals are estimated using an error-correction model**. In the regression model changes in house prices serve as the dependent variable, and the explanatory variables are meant to capture mainly demand-side factors. The regression takes the following form:

$$HPG_t = C + \theta \ A_{t-1} + \beta_1 \ HPG_{t-1} + \beta_2 YPC_t + \beta_3 \ credit_t + \beta_4 \ i_t + \ \beta_5 \ population_t + \epsilon_t$$

where HPG_t is the change in real house prices over the last quarter, YPC_t is the change in real GDP per capita over the last quarter, A_{t-1} is the affordability level of housing in the previous period, $credit_t$ is the change in real mortgage over the past year, i_t is an average lending interest rate, and $population_t$ is the change in population over the past year.

18. **The estimation uses quarterly data from the first quarter of 1994 until the first quarter of 2016.** The price measure used is the existing home price index from the BanRep database, and is deflated by the consumer price index (CPI).[10] The index measures the quarterly and annual evolution of existing houses in Bogota, Medellin, Cali, Barranquilla, Bucaramanga, Cucuta, Manizales, Neiva, Villavicencio and Soacha. Housing affordability is measured as the ratio of house prices to real GDP per capita.

19. **The econometric results show that real house prices in Colombia show long-run reversion to fundamentals (Table 1).** Affordability is negatively related to changes in house prices and is statistically significant: if house prices are out of line with income, there is a gradual tendency for this misalignment to be corrected (about 13 percent every quarter). All of the economic fundamentals have the expected sign and are significant. Better mortgage credit availability and higher income per capita promote higher house prices. Demographic factors do also have a positive effect on house prices. In contrast, the sign of the coefficient for the past growth rate of real house prices is not as expected and suggests that the current growth rate is negatively correlated with the past growth rate. Finally, the regression model seems to fit the data well given that the R-square stands at 0.45.

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[10] The results could change if the new home price index is used due to the historical gap between the existing and new home price indices. This robustness check is left for future work.

Table 1. Econometric Results

Source	SS	df	MS			
				Number of obs	=	85
				F(6, 78)	=	10.92
Model	.034456584	6	.005742764	Prob > F	=	0.0000
Residual	.04102643	78	.00052598	R-squared	=	0.4565
				Adj R-squared	=	0.4147
Total	.075483014	84	.000898607	Root MSE	=	.02293

hpi	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
hpi1	-.4009662	.0926514	-4.33	0.000	-.5854208	-.2165115
lnafford1	-.132468	.0315063	-4.20	0.000	-.1951922	-.0697437
dlnypc	.2093321	.1252894	1.67	0.099	-.0401	.4587642
rate	-.0017835	.0008625	-2.07	0.042	-.0035006	-.0000665
dlnc	.1200901	.0214842	5.59	0.000	.0773184	.1628619
dlnpop	5.079725	2.821283	1.80	0.076	-.5370173	10.69647
_cons	.1242847	.0373041	3.33	0.001	.0500179	.1985514

20.   The analysis suggests that house prices are moderately misaligned with respect to economic fundamentals (Table 2). The levels of house prices as of the first quarter in years from 2005 to 2008 are used as alternative base levels from which the fitted values of the house price increases are accrued. The approach is to assume that house prices were at the equilibrium level at an arbitrarily assigned date and set the house price index to 100. Then, the index values from that date onward are computed using the predicted house price changes from the regression analysis. Then, the estimated price gap is the difference between the actual index value and the predicted one. The estimated price gap would depend on when house prices are chosen to be at their equilibrium level implied by fundamentals. Thus, to ensure robustness, the misalignment is calculated as the average over these base years. In 2016, prices are considered misaligned if the average estimated gap is above 10 percent of the equilibrium price, and the average estimated price gap is at 13.5 percent.

Table 2. Estimated 2016Q1 Price Gaps for Alternative Base Levels

	2005	2006	2007	2008
Gap	17.76	15.40	10.96	9.89

21.   Among traditional valuation measures, only the price-to-rent ratio suggests overvaluation. The analysis of the price-to-income ratio relies on the supposed cointegration relationship between income and house prices. The idea behind the price-to-rent ratio is that the price of real estate, as an asset, should be in line with returns, revealed as market rent. For both ratios, the historical averages are calculated over the entire period for which data are available. House prices are considered overvalued if the ratio is at least one standard deviation above its historical average. Figure 7 shows that both valuation measures have been increasing steadily since 2011. However, only the price-to-rent ratio is above the overvaluation threshold.

Figure 7. Traditional Valuation Ratios

Price-to-income and Price-to-rent ratios
(2002Q1 to 2015Q2)

Sources: Fund Staff Calculations.
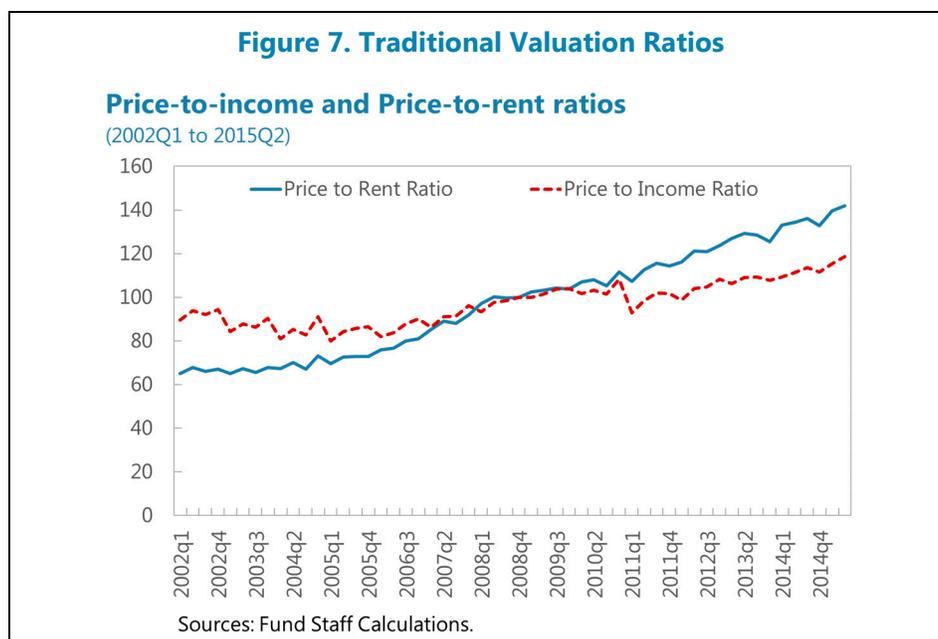
E. Macroeconomic Effects of Housing Shocks

22. **The macroeconomic implications of a potential house price correction can be assessed using a VAR model.** Following Aspachs-Bracons and Rabanal (2011) and Igan and Loungani (2012), the implications of movements in real house prices on GDP, private consumption, investment, and a nominal short-term interest rate are analyzed. House price shocks are identified using the generalized impulse response approach, which has the advantage of being invariant to the ordering of the variables.

23. **The estimation uses quarterly data from the first quarter of 1994 until the second quarter of 2016.** The domestic variables of interest are real GDP, real private consumption, real investment, the 90-day certificates of deposit interest rate, and the real existing house price index. All variables are introduced in the VAR in levels after taking natural logarithms, except for the nominal interest rate that is introduced directly in levels. The VAR is estimated using 3 lags.

24. **A house price correction could have significant spillovers to the rest of the economy.** Figure 8 shows the impulse responses of the five variables to a negative house price shock. The housing shock leads to a decline in real house prices of 2.5 percent after one period, and a cumulative decline of about 15 percent after two years. Real investment is the macroeconomics variable of highest sensitivity to the shock with an initial decline of 2 percent, and a cumulative impact of -21 percent over two years. Both real GDP and private consumption decline by more than 3 percent (cumulative) after 8 quarters.

Figure 8. Response of Macro Variables to a House Price Shock (±2 S.E.)

Real GDP

Real Private Consumption

Real Investment

Nominal Short-Term Interest Rate
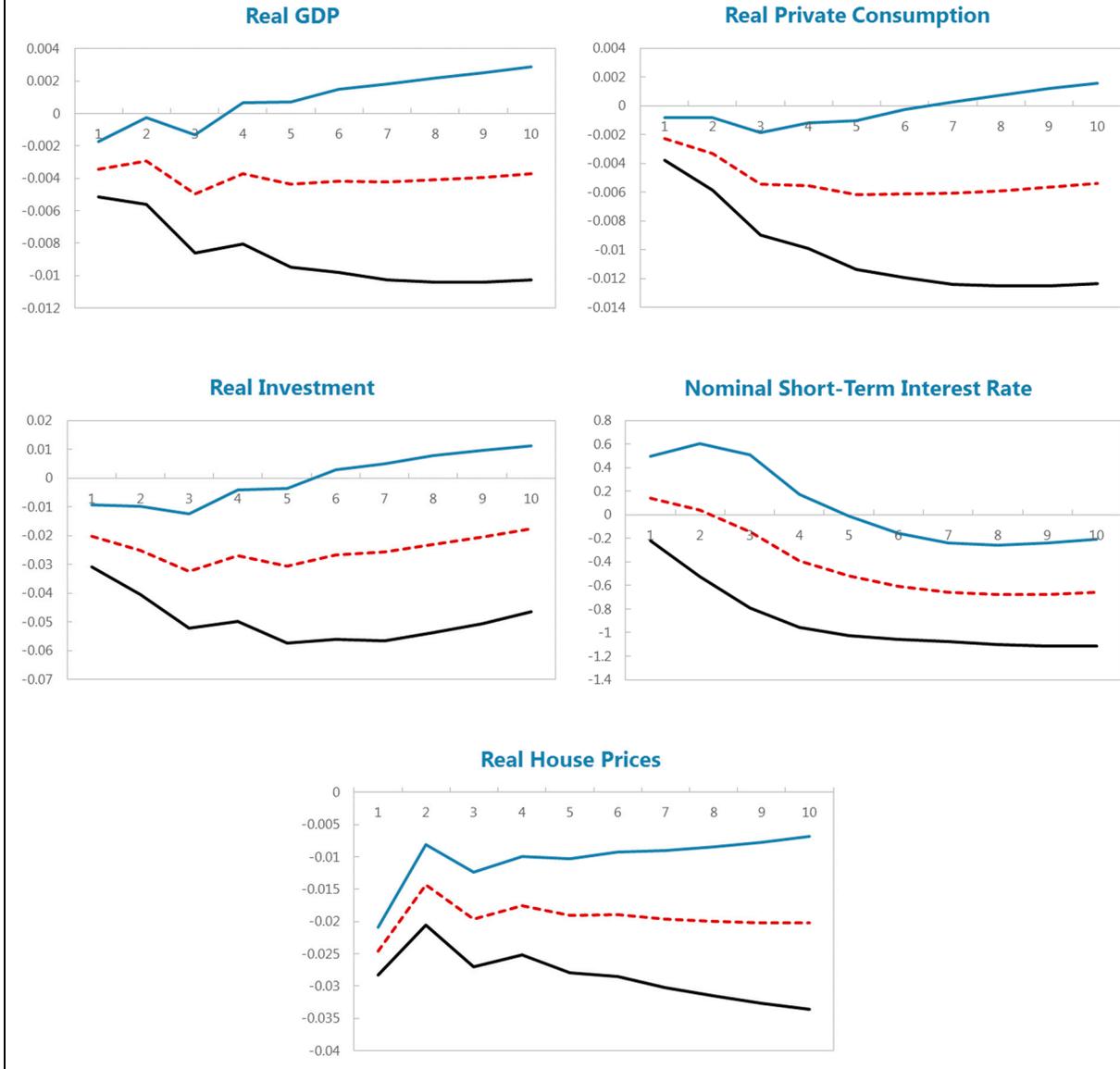
Real House Prices

F.   Conclusions

25.   Overall, risks from the housing market seem to be contained. While the results from the VAR model suggest that a negative house price shock could have sizable implications on activity (GDP, consumption and investment), house prices do not seem to be largely above levels justified by economic fundamentals (the average estimated gap is at 13 percent). Moreover, after the 1999 financial crisis the authorities have adopted macroprudential measures such as the use of LTV limits, which together with other housing financing characteristics, limit the vulnerabilities stemming from the housing market. At the same time, the current slowdown in economic activity should decelerate mortgage growth and impact the growth of house prices, which has started to show some signs of weakening. However, the authorities should continue to monitor closely the developments in credit and house price growth.

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POTENTIAL GROWTH IN COLOMBIA[1]

A. Introduction

1.   Colombia experienced an extended period of high growth up until 2014, against a background of rising commodity prices. Growth averaged 4.3 percent in 2000–14, while oil prices increased 241 percent. A liberalization of the oil sector allowed Colombia to double oil production. A large increase in labor participation and formalization supported growth. Favorable global conditions also played a role. IMF (2017, April WEO) identifies 2004–13 as a period of growth acceleration in Colombia, driven to a large extent by benign external conditions.

2.   The sharp and largely permanent decline in oil prices since 2014 took a toll on growth. GDP grew 3.1 and 2.0 percent in 2015 and 2016, as exports decelerated and domestic demand started adjusting to a lower level of national income. As noted in IMF (2015), oil exporters were expected to grow less than 2 percent below trend growth in 2015–17 and, more importantly, were projected to experience lower rates of potential GDP growth going forward.

3.   What are Colombia's growth prospects in a world of lower oil prices? Part of the recent economic slowdown is a temporary phenomenon associated to the transition to weaker terms of trade. It is however unlikely that Colombia will permanently return to the high growth rates of the early 2000s. The central thesis in this paper is that past employment gains and the large accumulation of capital that accompanied high oil prices are unlikely to be repeated in the near term. Nevertheless, the implementation of the peace deal together with macroeconomic stability and structural reforms, such as infrastructure and the tax reform, could set the stage for new growth drivers to emerge. This paper assesses the prospects for medium-term growth in Colombia in a world of low oil prices building on the insights from a production function. The technical details of the analysis can be found in Lanau and others (2017).

B. Insights from a Production Function

4.   Production function methods use information on capital and labor inputs, and productivity to estimate potential growth. This paper estimates and projects potential output in Colombia for the period 1990–2022, taking into account the impact of permanently lower commodity prices and planned policies on investment, labor markets, and productivity. The production function takes the following form

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

where Y is potential output, A is total factor productivity, K is the net capital stock in the economy, L is the potential labor input, and $1 - \alpha$ is the labor share in national income. An application of the production function to actual GDP growth shows that in recent years factor accumulation made a

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[1] Prepared by Sergi Lanau, Daniel Rodriguez-Delgado, and Jorge Roldós.

larger contribution to growth than productivity. The following subsections delve into the dynamics of each component of the production function. Data sources are listed in the annex.

Capital Input

5.   The composition of the capital stock in Colombia changed remarkably in the last three decades as a result of high commodity prices (Figure 1). Machinery and equipment grew from 3 percent to 9 percent of the total capital stock as a result of high growth in the oil and mining sectors. The capital expenditures of Ecopetrol—the largest domestic firm in the oil sector—and FDI to the sector provide evidence of how much mining investment grew. These two components of investment increased from 2½ percent of GDP in 2005 to 4½ percent of GDP in 2009–13.

Actual Growth Decomposition
(Percent)

Sources: DANE, Penn World Tables, and Fund staff calculations.

Figure 1. The Impact of Commodity Prices on Investment and the Capital Stock

Sources: DANE, IMF WEO, Banrep, Ecopetrol, and staff calculations.
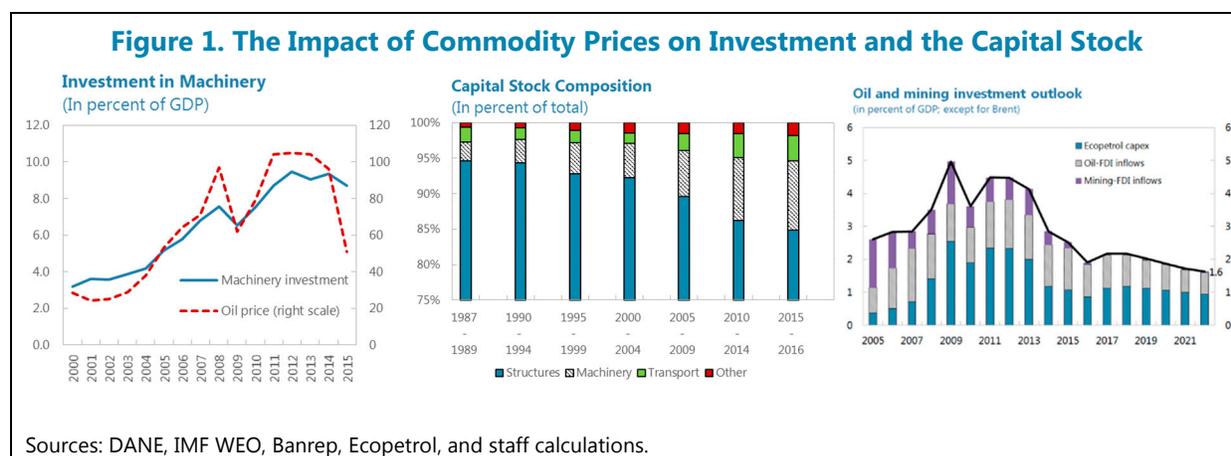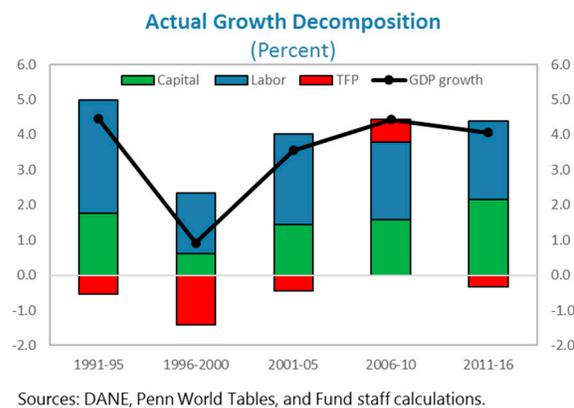
6.   The capital stock is projected to continue to increase, mainly as a result of 4G infrastructure projects and the tax reform. Oil and mining are unlikely to be a significant source of capital accumulation going forward but the outlook for investment in nevertheless positive. In a trend scenario without 4G infrastructure projects or tax reform, staff estimate that the net capital stock would increase at an average of 4.3 percent in 2017–22, given projected oil prices and budgeted public investment (Lanau and others 2017). The construction phase of 4G infrastructure projects is projected to add up to 0.1 percentage points to the average growth rate of the capital stock in the next five years.

7.   The structural tax reform will boost private investment, adding up to 0.1 percentage points to the average growth rate of the capital stock. As noted in chapter 3, investment is projected to grow by 3 percent as a result of the structural tax reform. Moreover, the mortgage

subsidies and new schools in the *Colombia Repunta* stimulus plan are likely to support construction and investment in structures in the near term.

8.   Infrastructure and the real exchange rate depreciation will increase corporate investment, adding a further 0.1 percentage points to the average growth rate of the capital stock (Box 1, and Lanau 2017a, 2017b). In addition to the aggregate demand and productivity effects of infrastructure, a further contribution to corporate investment is expected from the large real depreciation that accompanied the drop in oil prices. Staff analysis shows exporters invest more in response to depreciations.

9.   Taking into account the factors discussed above, the capital stock is projected to increase at an annual average of 4.3 to 4.7 percent in 2017−22 (Figure 2). The lower bound corresponds to a trend scenario with no impact from 4G infrastructure projects or the tax reform, while the upper bound incorporates the full impact of both policies on investment. The capital/output ratio would climb up to 2.6, from 2.4 in 2016.

Figure 2. Projected Investment and Capital Stock Growth Rates

Sources: DANE and staff calculations.
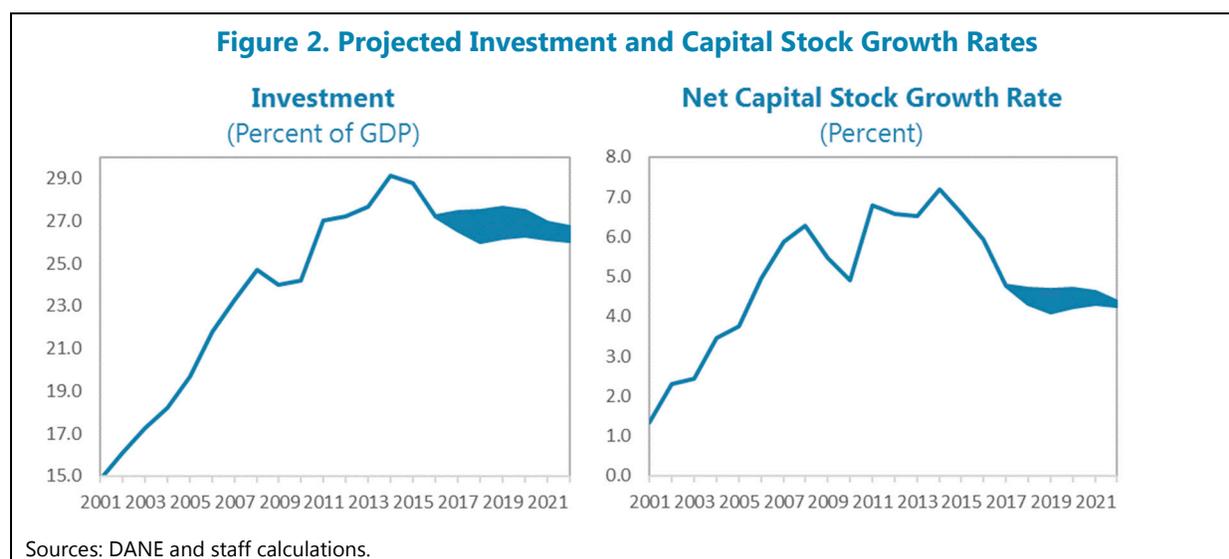
Labor Input

10.   The labor input to the production function grew strongly since the mid-2000s but its contribution to growth is expected to moderate in the next five years. Potential labor is projected to grow slightly above 2 percent per year in 2017−22, sharply down from an average of 3.8 percent in the last five years. The labor input can be broken down into working age population, potential labor force participation rate (LFPR), natural unemployment, and human capital. Each component is discussed in turn and summarized in Figure 3.[2]

[2] The LFPR and unemployment are filtered to obtain the potential LFPR and natural unemployment rate.

Box 1. The Impact of Infrastructure on Growth and Investment

Colombia scores weakly in the quality of infrastructure dimension of the Global Competitiveness Report (GCR) by the World Economic Forum. The 4G projects are an opportunity to improve infrastructure and lift investment and potential growth.

**WEF Quality of Infrastructure**

Source: World Economic Forum.

Lanau (2017a) explores the impact of infrastructure improvements on growth and corporate investment in Colombia and Latin America exploiting the variation in the dependence of sectors in the economy on infrastructure and the variation in the quality of infrastructure across countries.

The analysis shows that improving the quality and/or quantity of infrastructure increases growth in Colombia. More specifically, sectors that depend relatively more on infrastructure grow relatively faster when infrastructure improves. For example, if the quality of roads in Colombia according to the GCR improved to the sample median (the level in the Czech Republic), a sector with median dependence on transportation (hotels and restaurants) would growth 0.15 percentage points faster. At the aggregate level, GDP growth would increase 0.12 percentage points. A 10 percent increase in the size of the road network would increase growth by 0.14 percentage points. 4G infrastructure projects are expected to deliver an additional 7,000 kilometers of new primary roads.

Impact of Improving Road Quality on GDP Growth (Percentage points)

■ Improve to median
▨ Improve to upper quartile

Source: Lanau (2017a)

The corporate investment analysis shows that firms that depend relatively more on infrastructure increase investment when the quality of infrastructure improves. The investment rate of the median firm in Colombia would increase by about 0.1 percentage points if the quality of roads improved to the sample median. The nontraditional sectors that stand to benefit the most from the large real exchange rate depreciation in terms of investment are transport equipment, computers and electronics, and wholesale trade.

Impact on Median Investment Rate from Improving Roads (Percentage points)

Improve to median   Improve to upper quartile
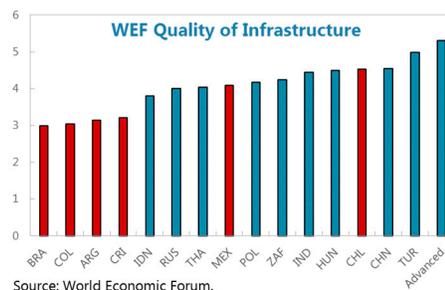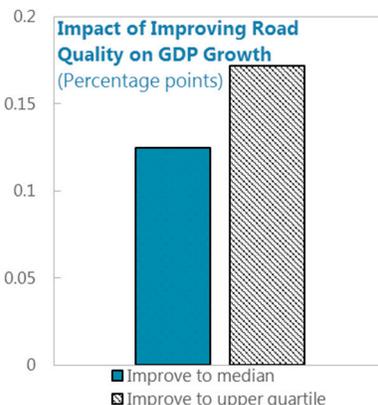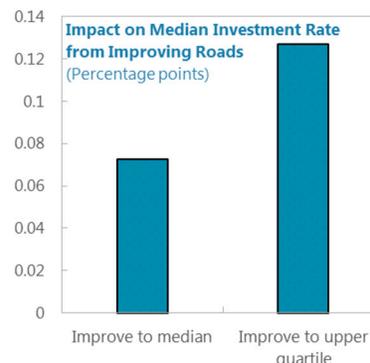
Source: Lanau (2017a)

Nontraditional sectors for which the impact of a 10 percent real depreciation on corporate investment rates is the largest

Other transport equipment

▨ Imported inputs channel
■ Export channel
—●— Total cumulative

Computers and electronics

Wholesale and retail trade
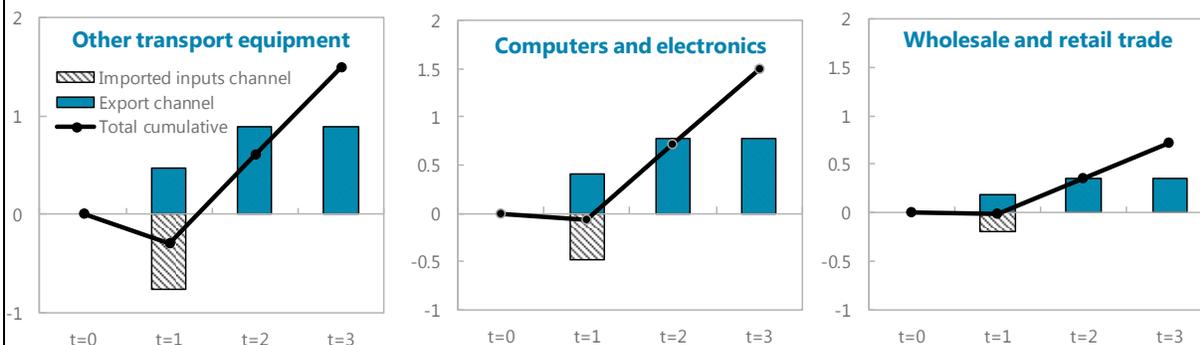
Source: Lanau (2017a)

- *Decelerating population growth*. Similarly to other emerging markets, DANE and UN projections point to slowing demographic trends in Colombia. Working age population is projected to grow at an annual average of 1.1 percent in 2017–22, down from 1.7 percent in 2000–16.

- *Plateauing LFPR*. The LFPR climbed to an all-time high of 64–65 percent in 2015–6, making a substantial contribution to the high growth rate of labor inputs. The LFPR is projected to remain at around current levels for the projection period since it is already high in international perspective. The gender gap is relatively large but Colombia's female LFPR is above the OECD average, limiting somewhat the scope for further gains.

- *Falling natural unemployment rate.* Unemployment has been on a declining trend since its peak shortly after the 1999 crisis. A modest cyclical uptick is expected in 2017 but as growth picks up, unemployment is projected to fall back to 9 percent.

- *Steady increase in the human capital stock*. The human capital stock increased steadily since 1990 but remains below that of a number of emerging markets. It is assumed that the human capital stock continues to increase at an unchanged rate in the next five years (around one percent). In the long-term, the human capital stock may increase faster since the end of the conflict with the FARC will help raise school enrollment rates in the affected areas. Improvements in the quality of education (Colombia's PISA scores were weak in 2015), could also boost human capital accumulation in the long run.

11.   Falling labor market informality helped improve the quality of labor inputs. It is well known that informal labor is less productive than formal one (Perry and others 2007, Dabla-Norris and others 2005). Informality fell 7 percentage points since 2001, indicating that the average quality of the Colombian labor force improved. Some provisions in the structural tax reform might extend this trend.

Labor market informality
(percent)
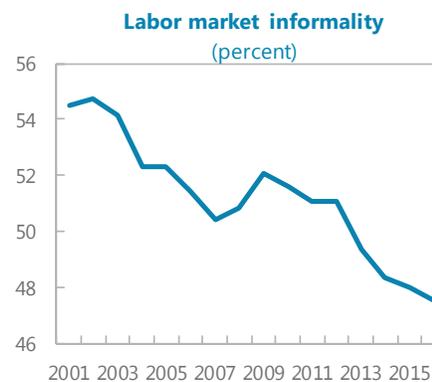
Source: DANE.

Productivity

12.   Total factor productivity grew significantly in the 2000s but was weaker in recent years (Figure 4).[3]

- A number of factors help explain the significant productivity improvements starting at the turn of the century: a sharp reduction in crime,[4] progress in financial deepening and financial

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[3] TFP is obtained as a residual from the log version of equation (1), using actual GDP, the capital stock adjusted by utilization, and actual employment adjusted by human capital. Potential TFP is the result of applying an HP filter (λ=6.25) to the TFP residual.

[4] See Cardenas and Rozo (2002) on the link between crime and productivity in Colombia.

inclusion (Karpowicz 2014), and a better business environment (e.g., cutting almost by half the days it takes to get a construction permit). Favorable terms of trade dynamics may have also been reflected in TFP (IMF 2017).


Figure 3. Labor Market Developments
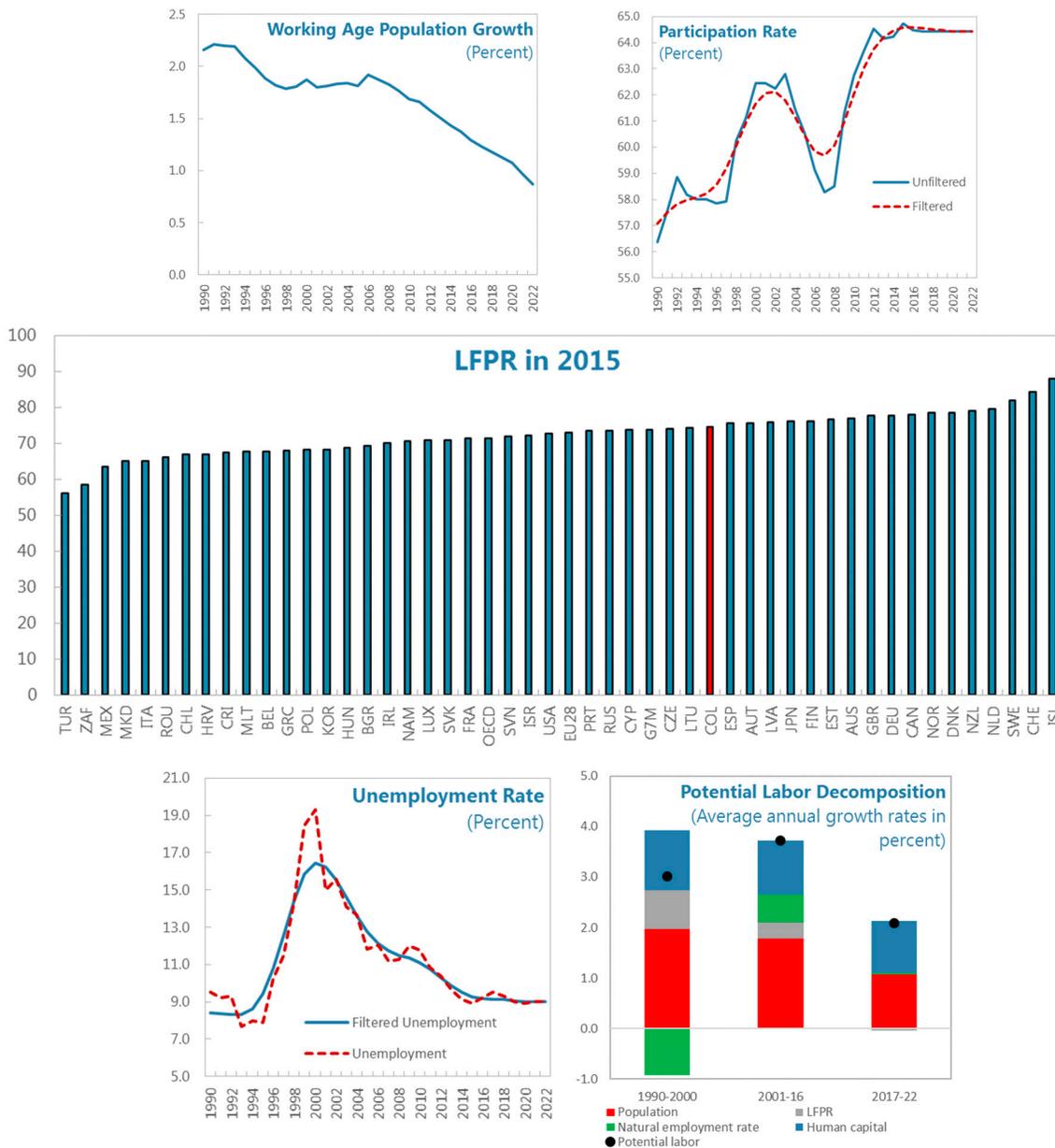
Sources: DANE, UN, OECD, Penn World Tables, and staff calculations.

- The recent decline in trend TFP is influenced by the sharp drop in measured TFP at the time of the financial crisis, which may largely reflect factors such as labor hoarding rather than fundamental productivity changes. But, as Sosa and others (2013) hypothesize, part of the recent decline in TFP could be related to the expansion of mining into areas of lower marginal productivity where production became profitable due to the commodity price boom. Moreover, the decline in TFP growth is a global phenomenon (Jones 2015, Haldane 2017).

- It is important to bear in mind the limitations of TFP as a measure of productivity. Since TFP is a residual, it can be contaminated by measurement errors in the labor and capital inputs (e.g., changes in the quality of the capital stock or fluctuations in hours worked). Labor productivity in the non-primary sector is an alternative productivity measure that avoids some of the pitfalls of TFP. As shown in Figure 5, Colombia's labor productivity grew at a healthy clip in 2003-08 according to this metric (although part of the improvement is due to capital accumulation, not pure productivity). In international perspective, though, Colombia's productivity is relatively low compared to other EMs.

Figure 4. Productivity Indicators

Source: DANE, OECD, and staff calculations.
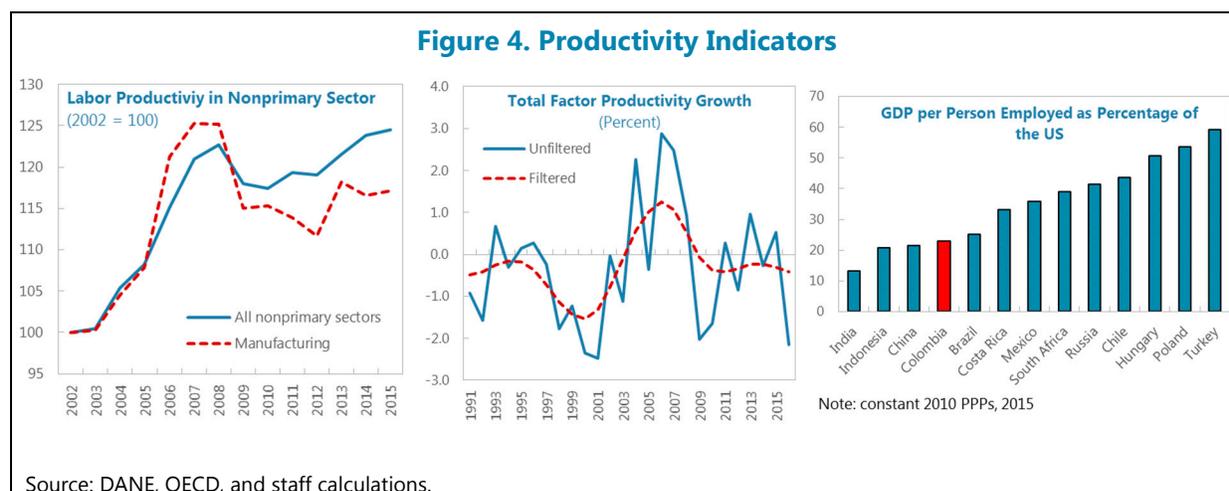
- Aggregate TFP figures mask large productivity differentials across firms and regions (Figure 5). As Brown and others (2013) document, the dispersion in firm productivity is larger than in OECD countries. IMF (2017) finds evidence of resource misallocation in the manufacturing sector in Colombia. The degree of misallocation is moderate in international perspective but correcting it could increase growth by 0.3 percentage points.

Figure 5. Measures of Productivity Dispersion
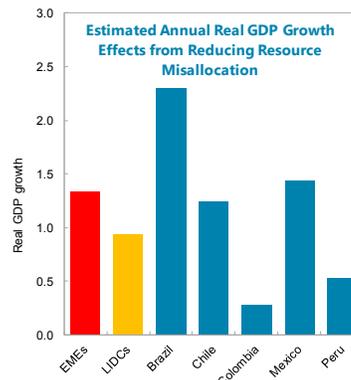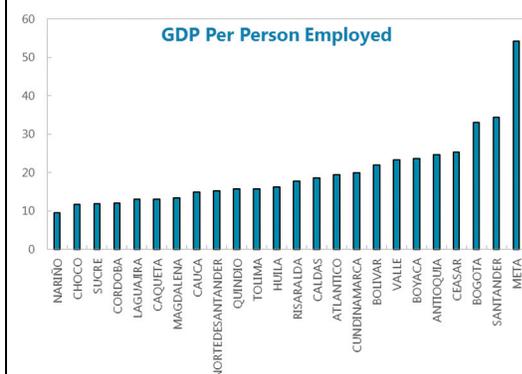
Sources: DANE, IMF (2017).

Note: Estimates of resource allocation efficiency follows Hsieh and Klenow (2009). Estimates correspond to the latest available data for the manufacturing sector.

- Low spending in R&D may also be hindering productivity growth. CONPES (P.40) notes this issue, as well as the little coordination between centers producing knowledge and the private sector, and points out a number of policy measures to address it.

13.   Going forward, productivity growth could reach one percent in a scenario with very strong reform implementation but could be much weaker in the absence of reforms. TFP growth would gradually increase to 1.1 percent in 2022 if the positive effects of the following factors materialize in full:

- Productivity gains from better infrastructure (0.25 percentage points). Improvements in infrastructure as a result of the 4G projects will make the existing stock of capital and labor more productive, especially in rural areas where the infrastructure gap is the largest.

- The peace dividend (0.5 percentage points). Further improvements in security as a result of the peace agreement with the FARC will improve business confidence and productivity in the areas most affected by the conflict. Together with peace-related public spending, this will help close the large productivity gaps across firms and regions. In the long-run, the peace dividend could grow further, reaching up to 0.7 percentage points in terms of productivity growth.

- Productivity gains from the tax reform (0.1 percentage points). The simplification of the tax system will make firms more productive as the cost of filing taxes falls.

- Ongoing efforts to improve the business environment and reduce barriers to trade (0.1 percentage points). Recent progress at the planning department (DNP) to streamline regulations and reduce subsidies in line with best OECD practices has the potential to improve productivity. The recently approved customs code and a planned simplification of import tariffs should make firms, especially exporters, more productive. Removing nontariff barriers (Garcia

and others 2016) as well as efforts to promote new export markets and products will also contribute to productivity growth.

Putting it all Together: Potential Growth

14.   **Factor accumulation, especially labor, drove potential growth up to an average of 4 percent in the last 15 years.** High population growth, a large drop in the unemployment rate, and improving schooling rates increased labor inputs significantly. Together with increasing capital accumulation and some TFP gains, these developments lifted potential growth to above 4 percent on the eve of the global financial crisis.

15.   **Medium term potential growth would be in the 2.8 to 4.1 percent range depending on the strength of policies (Figure 6).** The lower bound is an unlikely scenario where incomplete reform implementation results in no TFP growth, and the effects of 4G infrastructure projects and the tax reform on investment do not materialize. The upper bound corresponds to one percent TFP growth by 2022 due to very strong structural reforms and full impact of policies on capital accumulation. A central scenario with medium term potential growth of 3.5 percent is shown in Figure 6. While less optimistic than the upper bound, the central scenario still involves a significant turnaround in productivity that requires strong reform implementation.

Figure 6. Potential Growth Projections

Sources: DANE, UN, OECD, Penn World Tables, and staff calculations.
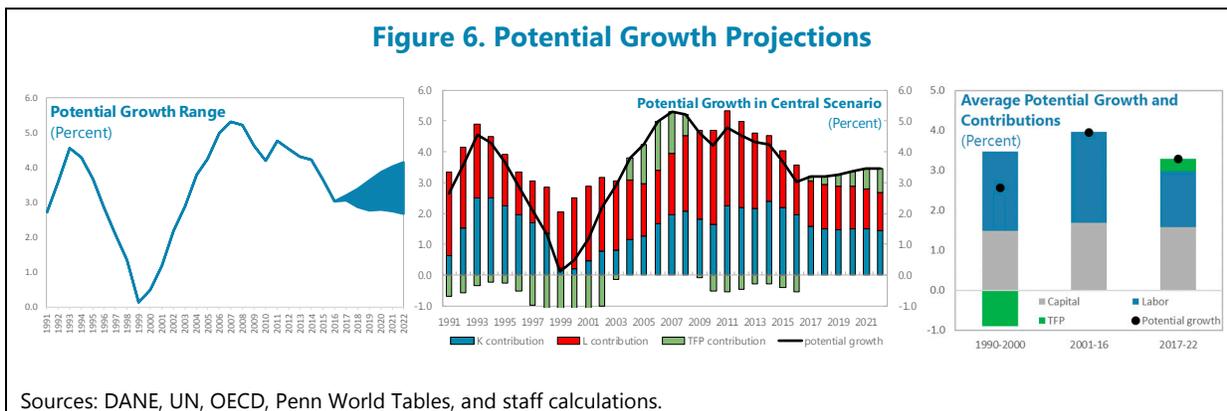
16.   **Further reductions in the natural unemployment rate and informality could increase potential growth but may be offset by other developments.** It is conceivable that unemployment and informality fall below the assumptions in the production function exercise. However, growing skill mismatches and concerns about the quality of education may offset the gains.

17.   **Declining potential growth is a common theme among commodity exporters and highlights the importance of structural reforms to grow in a world of low**

Potential Growth
(Percent)

Source: April 2017 WEO.
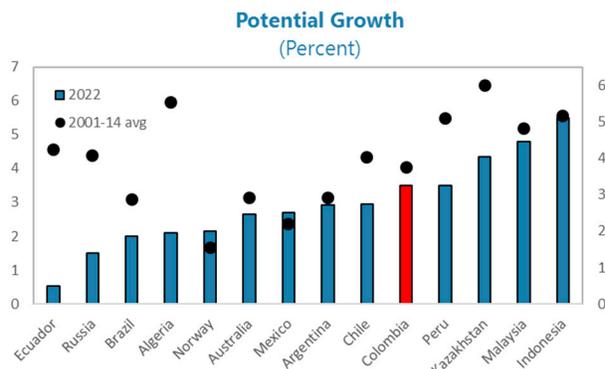
oil prices. Potential growth is expected to soften in most commodity exporters. In many cases, the decline is projected to be significantly larger than Colombia's.

C.   Conclusion

18.   Potential growth is likely to moderate to a range of 2.8 to 4.1 percent in a world of lower oil prices. The results from a production function indicate that potential growth rose to 4–5 percent in the era of high oil prices. Potential growth estimates fell considerably with the sharp drop in oil prices but the outlook is positive under successful implementation of structural reforms:

- The 4G infrastructure projects and the tax reform will increase investment, offsetting the sharp decline in capital accumulation in the oil sector. Capital accumulation is projected to contribute 1.4 to 1.6 percentage points to average annual potential growth in 2017–22, highlighting the importance of executing 4G projects without delays.

- Improvements in productivity are essential to lift potential growth. The large increases in the labor force observed in the last 15 years are unlikely to continue, making productivity-enhancing reforms central for growth. Better infrastructure, the peace agreement with the FARC, and ongoing efforts to improve the business environment and reduce trade barriers are welcome steps to boost productivity and growth.

COLOMBIA

Annex I. Data Sources

Data Sources

Variable	Source
GDP	DANE and staff projections
Employment, unemployment, working age population	DANE
Working age population projections	DANE and UN
Human capital index	Penn World Tables
Capital stock	DNP and Banrep
Depreciation rate	Staff calculations
Oil price	WEO

36   INTERNATIONAL MONETARY FUND

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THE GROWTH IMPACT OF THE 2016 STRUCTURAL TAX REFORM[1]

A. Introduction

1.   **The structural tax reform approved in December 2016 aims to mobilize revenue to replace lost oil proceeds, while fostering employment and growth; in this chapter, we attempt to quantify the growth impact of key elements of the reform.**

2.   **The recent literature provides economic models suitable to analyze the impact of the tax reforms in Colombia**. BanRep's Fisco (Rincón et al 2015), and IMF's FSGM (2016) share key ingredients including a rich array of fiscal instruments and an important role for public capital to foster private sector competitiveness.

3.   **This papers applies the IMF's FSGM model to analyze the impact that the proposed changes of direct and indirect taxes would have on GDP growth.** In short, simulations show that: 1) the direct growth impact of the reform will start small and average about 0.3 percent of GDP between 2017–22, and 2) the contribution to growth comes from the reform's boost to private investment and productivity. After providing an overview of the Colombia's tax system, FSGM model and simulations, the chapter's concluding remarks outline some areas in which the analysis could be expanded.

B. Brief Diagnosis of Colombia's (pre-Reform) Tax System[2]

4.   **The importance of the structural tax reform approved in December 2016 has been highlighted in multiple recent studies.** A key issue discussed in previous IMF consultations (2014, 2015, and 2016) is that without further revenue mobilization, public expenditure, including social and infrastructure expenditure, would have to decline significantly in order to comply with the medium-term deficit reduction mandated by the fiscal rule. Such expenditure restraint amid still large social and infrastructure needs in Colombia, is not desirable. OECD (2015) also argues for the need of an overall simplification of the tax system and strengthening of tax administration as its complexity contributes to widespread evasion. The final report of the ECTR (Expert Commission for Tax Reform) documents that the multi-tier income tax system is contributing to complexity, lack of progressivity and significant dispersion of (implicit) taxation across economic sectors.

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[1] Prepared by Daniel Rodriguez-Delgado. Model estimations produced in collaboration with Keiko Honjo and Ben Hunt. The paper benefited from comments received in seminar presentation at the Central Bank of Colombia.

[2] This section is based in part on the final report of the tax experts independent commission the Colombian government invited in 2015 to provide advice on the design of the tax reform. The report can be obtained at: https://comisionreformatributaria.wordpress.com/

5.   The Colombian tax system has been subject to multiple reforms. Among the most recent ones, the 2012 structural tax reform aimed to improve labor formality and tax progressivity while being revenue neutral. It replaced part of payroll taxes with an earmarked corporate income tax (CREE) that would coexist with the traditional corporate income tax (CIT); and introduced a new tier in the personal income tax (PIT) akin to the US's alternative minimum tax (AMT) denoted in Colombia as IMAN. The 2014 tax reform aimed to replaced lost oil revenue as the commodity supercycle started to wane. Its key measure was a temporary increase in CREE.

6.   Colombia's tax revenue is somewhat below the regional average, but with important compositional differences. Key features include:

- **Total income tax revenue in Colombia is above the level in some of its peers, yet it comes almost exclusively from CIT**. Due in part to the increase in CIT in the 2014 reform, CIT revenue exceeds Chile's and Mexico's. At the same time, the scheduled increase in CREE for the next few years would have placed Colombia's combined CIT+CREE well above its peers (43 percent versus 27.2 percent average in LatAM). On the other hand, the relatively large exempt income bracket and deductions erodes the PIT's tax base and hinders the progressivity of the overall tax system.

**Tax-to-GDP ratios, 2015**
(in percent of GDP)
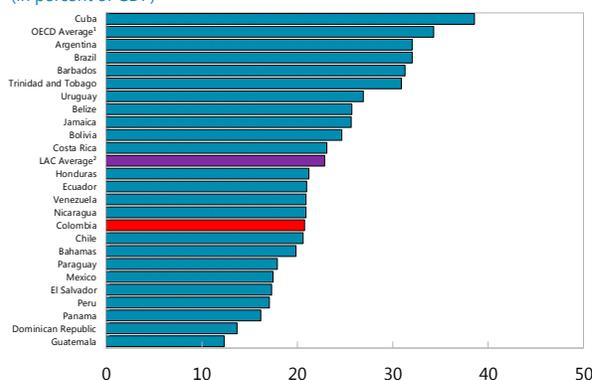
Source: OECD.

Components of General Government Revenue (% GDP)
Colombia and comparator countries, 2015
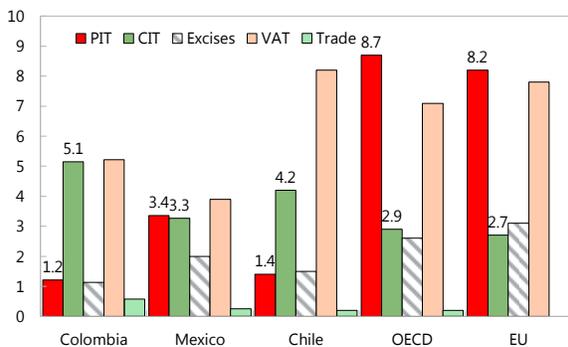
Source: OECD Revenue Statistics.

**Corporate tax rate comparison**
(in percent of GDP)
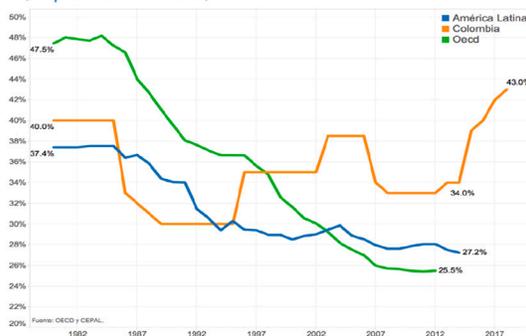
- **VAT revenue suffers from weak productivity** due in part a relatively large number of exempted goods. VAT revenue outperforms Mexico's but significantly behind Chile's and the OECD average. As reported by the OECD, the productivity of VAT in Colombia—VAT revenue ratio that measures VAT revenue vs what would theoretically be raised if VAT was applied at the standard rate to the entire potential tax base in a "pure" VAT regime and all revenue was collected as described in OECD (2015)—ranks among the lowest in the region. Further, Colombia's mixed performance on VAT revenue is despite having the not-common feature of not crediting VAT paid on capital goods (collects about 0.6 percent of GDP).

- **The complexity of the tax system represents a heavy burden to the tax authority and tax payers and contributes to tax evasion**. The complexity of the system coupled with limited human and technological resources and a limited adoption of electronic invoicing constrain the impact of tax administration efforts from the tax authority (DIAN)—which nevertheless have obtained about 1 percent of GDP of additional revenue from tax administration over the last

VAT revenue ratio (VRR) in LAC countries, 2014
(in percent; see text for definition)

Source: OECD.

3 years. Likely due in part to its complexity, there is a widespread problem of tax evasion in Colombia. Recent estimates (see OECD 2015) suggests that tax evasion in VAT and Income taxes combined represent up to 4 percent of GDP (which is about one fourth of the total tax revenue collected nowadays).

- **Wide dispersion of effective tax rates.** Extensive use of special treatment to some goods (e.g. in VAT) and sectors (e.g. hotels, construction, zona franca, etc.) have resulted in a wide dispersion of effective tax rates across sectors. Recent studies suggest taxation might be an important driver of resource misallocation in emerging markets (Fiscal Monitor April 2017).

C. Key Elements of the 2016 Structural Tax Reform

7.   **The reform's goal is twofold: secure enough revenue to protect key expenditure programs while complying with fiscal consolidation mandated by the fiscal rule as well as to foster employment and investment.** To the first goal, the revenue aims to collect about 3 percent of GDP by 2022 which would allow to keep a broadly constant level of primary expenditure as a ratio of GDP. To achieve the second goal, the reform reduces the corporate tax burden including by lowering the CIT and allow to credit the VAT paid on capital goods against CIT.

8.   **The expected revenue yield will come from some key measures.** An increase in the VAT general rate by 3 percentage points (from 16 to 19 percent) will generate about 1 percent of GDP; while anti-evasion measures and gains from formalization and growth will each generate about

0.6 percent of GDP. The reform also includes green taxes and some reductions in the exemptions for Personal Income Tax (PIT). It is important to note that the reform counts as net revenue the extension of the existing Financial Transaction Tax (FTT) that was scheduled to gradually disappear starting in 2019 (currently, the FTT generates about 0.8 percent of GDP).

Colombia: Key Elements of Structural Tax Reform

Expected revenue from selected measures (in percent of GDP)						
	2017	2018	2019	2020	2021	2022
Total	0.7	0.7	1.7	2.5	2.8	3.1
VAT and consumption tax	0.7	0.8	0.8	0.9	0.9	0.9
o/w deduct. VAT on capital goods.	0.0	-0.2	-0.2	-0.1	-0.1	-0.1
Green taxes	0.1	0.1	0.1	0.1	0.1	0.1
Personal income tax	0.0	0.1	0.1	0.1	0.1	0.1
Corporate income tax	-0.1	-0.3	-0.1	-0.1	-0.1	-0.1
Extension of Financial Transaction Tax	0.0	0.0	0.2	0.4	0.7	0.9
Formalization and Growth 1/	0.0	0.1	0.3	0.7	0.6	0.7
Anti-evasion measures	0.0	0.0	0.3	0.5	0.6	0.6
For simulation:						
VAT excluding capital goods	0.7	1.0	1.0	1.0	1.0	1.0
CIT + VAT on capital goods	-0.1	-0.5	-0.2	-0.2	-0.2	-0.2

Source: National authorities and Fund staff estimates

1/ Includes revenue from taxation to non-profit entities; single tax for small taxpayers (monotributo)

9. **The simulations to be presented next will focus on the impact of changes to VAT and CIT.** In particular, the simulations will focus on the combined impact of the deductibility of VAT paid on capital goods together with the lower CIT. The next table describes the impact of the reform on corporate income taxation by the combined effect of CIT and CREE. The simulations will also include the impact of the increase in VAT so that to avoid *double counting*, the VAT revenue lost from allowing the deductibility of capital goods will be removed from such entry as described in the memo items in the table above.

Reform Changes to CIT (In Percent)

	2017	2018	2019	2020	2021	2022
Combined No Reform	42	43	34	34	34	34
CIT	34	34	34	34	34	34
CREE	8	9	0	0	0	0
Combined Reform	40	37	33	33	33	33
CIT	34	33	33	33	33	33
CREE	6	4	0	0	0	0
Memo:						
Reform-No Reform	-2	-6	-1	-1	-1	-1

Source: National authorities

D.   Evaluating the Growth Impact of the Reform: Literature Review and the FSGM Model

10.   The literature on the growth impact of fiscal policy (fiscal multipliers) provide some useful benchmarks for the simulations in this paper. Batini et al (2014) offer a literature review and find that among the existing literature for emerging markets, the evidence suggests fiscal multipliers are smaller in emerging markets; and that tax multipliers and similar to expenditure multipliers (in the range of 0.1–0.4). The authors also identify structural factors that could lead to larger multipliers including, lower trade openness, more rigid labor markets and less flexible exchange rates.

11.   A relevant benchmark of the estimates presented here is Rincon et al (2014) which estimates multipliers for Colombia using a dynamic stochastic general equilibrium (DSGE) model. The model (denoted FISCO) includes fiscal and monetary policy rules that endogenously react to shocks and *policy changes* to achieve medium-term targets. An important feature of the model is that public capital is modelled as an essential input in the production of some domestic goods. It finds a public investment multiplier is between 0.4 and 0.5. In contrast, public consumption multiplier depends heavily on the degree of response of monetary policy and of any other fiscal policy instrument used to achieve the fiscal rule targets and on average is about -0.02. Another useful reference is Vargas et al (2012) who employ a non-linear SVAR and estimate expenditure multipliers of about 0.4 and argue that data suggests multipliers have increased as the country's overall fiscal position has improved since the 1990s.

12.   The FSGM model shares some key properties of Rincon et al (2014) and provides a semi-structural framework to analyze policy changes.[3] The Flexible System of Global Models (FSGM) is a semi-structural general equilibrium model that can be calibrated to specific countries. It incorporates a rules-based fiscal and monetary policy and a combination of OLG (Non-Ricardian) and liquidity constrained consumers (LIQ). Private consumption and investment are modelled structurally (micro-founded), while for other parts of the model (e.g. labor supply, price determination) a reduced-form is used.

13.   Central to the analysis in this paper, the model poses that public capital (deviations from trend) positively affect total factor productivity and hence returns to private investment which is modelled through a Tobin's Q model of quadratic adjustment costs. Intuitively, the model captures cases such as public investment in infrastructure that would allow better use of existing private resources. Similarly, to Rincon et al (2014), fiscal policy is modelled as the combination of different instruments including indirect and direct taxes as well as oil-related royalties and lump-sum transfers to households. The model includes a fiscal rule that ensures a stable debt to GDP ratio in the long-run, while monetary policy is guided by a Taylor rule.

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[3] This brief description of the FSGM model is based on Andrle et al. (2015) which includes a comprehensive description of the model.

E. Simulations

14.   The simulations presented next aim to estimate the growth impact of key elements of the reform. Some remarks are in order. First, the simulations should be understood as the estimation of the joint impact of revenue and expenditure measures. The simulation includes the expected revenue yield for PIT, CIT and VAT (as described above) and also the fact that such revenue proceeds are devoted to public investment. Second, the estimation includes the endogenous response of monetary policy to the tax reform. That is, if the reform were to push GDP above its potential level, inflationary pressures would build and monetary policy will endogenously respond by hiking policy rates. Finally, the simulation depicts the additional growth versus a no-reform steady state, but not necessarily versus the latest observed growth rate.

15.   To further illustrate the growth impact of public capital this section also includes a simulation of the impact of the 4G infrastructure agenda.[4] To do so, the simulation includes the expected 4G capex between 2016-2021. Hence, the estimated growth yield is of the *building phase* of the agenda, and not necessarily of the additional GDP growth the agenda could generate once it is finished. At the same time, this way to model the 4G agenda is not without limitations as in practice the agenda is PPP-based and will be in practice accounted as private investment. By modelling it as public investment, the simulations include wider fiscal deficits. As the built-in fiscal rules aim to stabilize deficits, the results below will be somewhat biased by also incorporating some gradual fiscals tightening designed to restore deficits to steady state levels.

4G Infrastructure Agenda Capex (In Percent of GDP)

|	2016	2017	2018	2019	2020	2021
Capex	0.23	0.94	1.17	1.05	0.81	0.37

Source: National authorities and Fund staff estimates

- **Growth impact.** The simulations show the reform could boost growth by about 0.3−0.4 percent of GDP per year which builds up gradually as the reform total yield and hence the additional public investment start small (0.5-0.6 percent of GDP in 2017−18) and then increased slightly after (to 0.8 percent of GDP). The charts above also suggest, the reform would boost GDP above its trend level; in other words, thecontribution of the reform to potential GDP

GDP Growth
(%pt Difference)

Tax reform only
Tax reform+4G

Output Gap
(%pt Difference)

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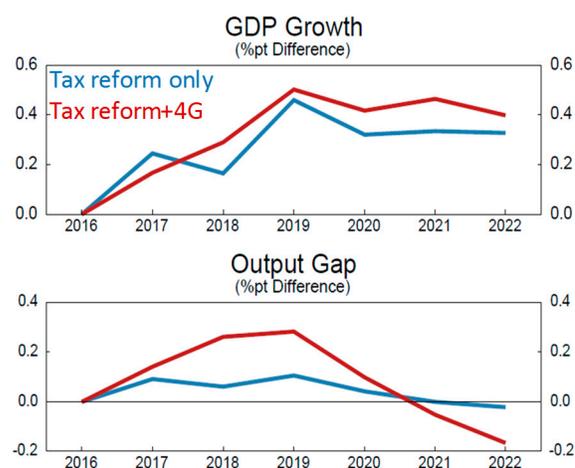
[4] For an overall description of the 4G agenda, see 2015 Selected Issues Paper. IMF Country Report No. 15/143.

(including the boost to TFP from additional public investment) will be milder than the impact on headline GDP.

- **Private investment and consumption.** The reform will change the composition of domestic demand with the increase in VAT leading to temporarily lower consumption and the combination of lower corporate taxation and additional public capital will boost private investment. After 2018, private consumption will recover and exceed a no-reform scenario boosted in part from additional labor income as firms will expand production and employment. The 4G agenda will reinforce the positive impact on investment and consumption.

- **Public investment and total factor productivity.** Both of these two factors will boost growth. The reform proceeds will allow additional public investment also strengthened by the 4G agenda. Additional public investment will lead to higher public capital and result in an increase *cumulative* increase in TFP *levels*.

- **Inflation and monetary policy response.** As the simulations suggest headline GDP will exceed potential GDP during the first years of the projection, inflation will tend to increase which will lead to an endogenous response of monetary policy. The simulations show monetary policy rates would be about 50bp and 125bp higher under a tax reform, and tax reform and 4g scenarios, respectively. Hence the growth impact discussed above should be understood as the join impact of fiscal and monetary policy in response to the reform.

Real Consumption
(% Difference)

Tax reform only
Tax reform+4G

Real Investment (Private)
(% Difference)

Real Government Investment
(% Difference)

Tax reform only
Tax reform+4G

Trend total factor productivity
(% Difference)

Core CPI Inflation
(%pt Difference)

Tax reform only
Tax reform+4G

Policy Interest Rate
(%pt Difference)
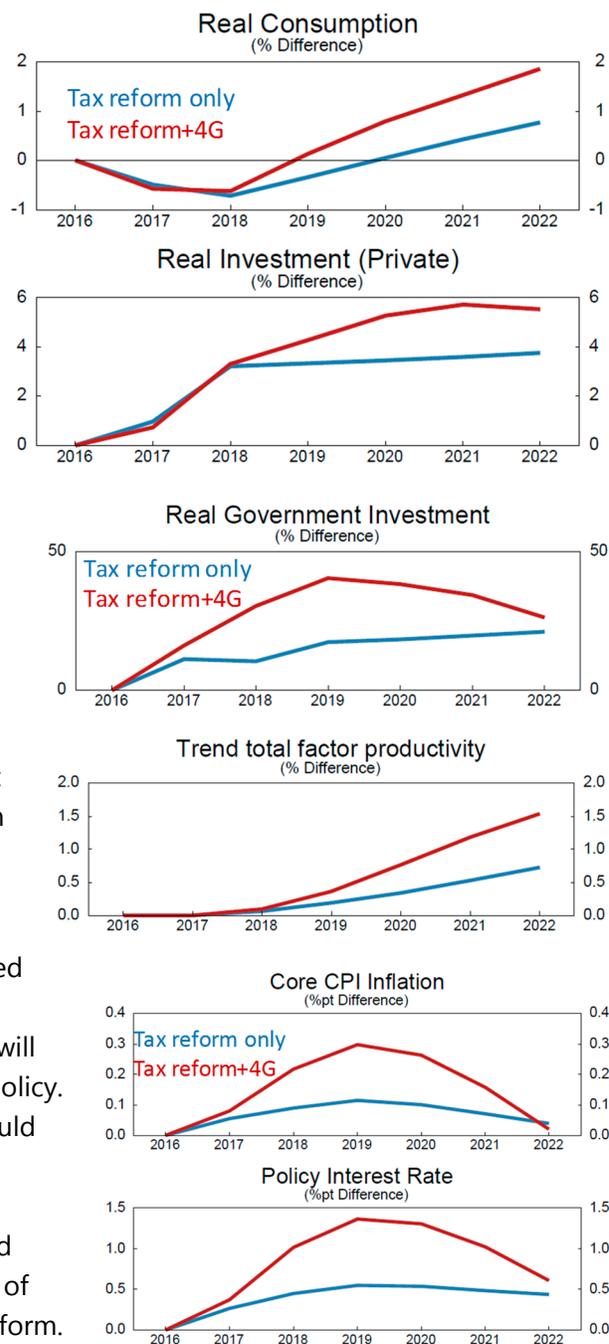
F. Concluding Remarks and Potential Extensions

16.   The simulations presented in this chapter suggests the tax reform approved in 2016 stands to advance on the authorities' objective to promote growth. The results are driven not only by the boost to private investment but also due to the additional public investment the reform will allow.

17.   There are several dimensions where the above analysis could be refined and expanded.

- **Elements of the reform.** As mentioned above the simulations in this paper cover only some key elements of the reform. It could be useful to also model the impact of the extension of the FTT and green taxes. The former might impact growth through the credit channel while the latter could generate a distinction across industrial sector depending on their reliance on fossil fuels.

- **Effect on risk premia.** Something not considered in the analysis in this paper is the impact that the reform could have on Colombia's risk premia and consequently on the cost of funding for firms and consumers. As some rating agencies had conditioned Colombia's rating on the approval of the tax reform, the simulations could include a reduction on risk premia as part of the reform scenario. The model could likely generate higher private investment in that case.

- **Quality/effectiveness of public capital.** Given that the estimated growth impact is due in part due to formation of public capital, it could be useful to incorporate as part of the model's parameters the effectiveness through which resources devoted to public investment become public capital.

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